M5 Series

Diagnostic Ultrasound System

Service Manual

Contents

Revision History I

Intellectual Property Statement II

Responsibility on the Manufacturer Party II

Warranty III

Return Policy IV

1 System Overview 1-1

1.1. Intended Use 1-1

1.2. Product and Model Code 1-1

2 Introduction 2-1

2.1. Introduction of Unit 2-1

2.2. Extend Modules 2-3

2.3. Control Panel 2-5

3 Principle Description 3-1

3.1. Electric Principle of the System 3-1

3.2. Principle of Boards 3-2

3.2.1. Power System 3-2

3.2.2. Principle of Main Board 3-9

3.2.3. Principle of Transmission Board 3-33

3.2.4. Principle of CW Board 3-34

3.2.5. Principle of Keyboard Board 3-42

3.2.6. Principle of ECG Board 3-49

3.2.7. Principle of Video/Audio Capture Card 3-52

3.2.8. Principle of Transducer Extension Module 3-53

3.3. Software Startup 3-56

4 Structure and Assembly/Disassembly 4-1

4.1. Explosive Figure of the Complete System 4-1

4.2. Field Replaceable Unit 4-3

4.3. Structure and Assembly/Disassembly 4-11

4.3.1. Removing Battery 4-11

4.3.2. Removing Display Assembly 4-11

4.3.3. Removing Top cover main unit 4-16

4.3.4. Removing the Power Board 4-20
4.3.5. Removing Battery Connection Board 4-23
4.3.6. Removing Continuous Wave Doppler Board 4-24
4.3.7. Removing CPU Fan 4-25
4.3.8. Removing CPU Board and Radiator Module 4-27
4.3.9. Removing the System Fan 4-29
4.3.10. Removing Speakers 4-30
4.3.11. Removing Transmission Board 4-31
4.3.12. Removing Main Board and Transducer Board 4-32
4.3.13. Removing Transducer Board 4-33
4.3.14. Removing HDD 4-34
4.3.15. Removing Transducer Extension Module 4-36
4.3.16. Removing ECG Module 4-39
4.3.17. Removing Video and Audio Capture Module 4-40
4.3.18. Removing Data Extension Module 4-42
4.3.19. Disassemble the Dust Net 4-42

5 Function and Performance Checking Method 5-1

5.1. Note 5-1
5.2. System Running Status 5-1
5.2.1. Running Status 5-1
5.2.2. Working Condition 5-1
5.3. General exam 5-2
5.3.1. Check Flow 5-2
5.3.2. Checking Content 5-2
5.4. Function Checking 5-4
5.4.1. Checking Flow 5-5
5.4.2. Content 5-5
5.5. Performance Test 5-11
5.5.1. Test Process 5-11
5.5.2. Test Content 5-11

6 System Software 6-1

6.1. Software Maintenance 6-1
6.1.1. Entering Preset 6-1
6.1.2. Viewing System Information 6-1

6.1.3. Data Management 6-2
6.1.4. Maintenance Status 6-3
6.1.5. Software Upgrade 6-4
6.1.6. Enter Windows 6-7
6.1.7. Model Setup 6-7
6.1.8. Installing Optional Software 6-8
6.2. System Self-diagnosis 6-9
6.2.1. Screen Introduction 6-9
6.2.2. Item Select Area 6-10
6.2.3. Info Display Area 6-10
6.2.4. Status Bar 6-11
6.2.5. Structure Diagram Area 6-11
6.2.6. Description of Self-diagnosis Test Items 6-12
7 Care and Maintenance 7-1
7.1. Overview 7-1
7.1.1. Tools, Measurement Devices and Consumables 7-1
7.1.2. Care and Maintenance Items 7-1
7.2. Cleaning 7-3
7.2.1. Clean the System 7-3
7.2.2. Content 7-3
7.2.3. Clean the Peripherals 7-5
7.3. Checking 7-6
7.3.1. General check 7-6
7.3.2. System Function Check 7-6
7.3.3. Peripherals and Options Check 7-7
7.3.4. Mechanical Safety Inspection 7-7
7.3.5. Electrical Safety Inspection 7-9
8 Troubleshooting of Regular Malfunctions 8-1
8.1. Recover after the operating system is damaged 8-1
8.2. Recover after the ultrasound software is damaged 8-2
8.3. Recover after the patient database is damaged 8-4
8.4. Recovering after HDD fails 8-4
8.5. Inspection flowchart for power adapter and dc-dc circuit 8-6
8.6. Inspection flowchart for battery and charging 8-7

8.7. Inspection flowchart for black screen 8-8
8.8. Inspection flowchart for image area without echo signal 8-8
8.9. Inspection flowchart for image with black area 8-9
8.10. Abnormal Image in an Image 8-10
8.11. Abnormal CW Image 8-10
8.12. Service Flow Cannot Start 8-10
8.13. Troubleshooting for PC System 8-10
8.14. Troubleshooting for CW board 8-11
8.15. Troubleshooting for the keyboard board 8-12
8.16. Troubleshooting for ECG board 8-13
8.17. Troubleshooting for video & audio capture card 8-15
8.18. Troubleshooting for transducer extension module 8-16

Appendix A Interface Definition Index A-1

Appendix B Electrical Safety Inspection B-1

Appendix C Phantom Usage Illustration C-1

Revision History

Mindray may revise this publication from time to time without written notice.

Revision	Date	Reason for Change
12.0	2012.3.30	1. Increase “4.2 Field Replaceable Unit” list with pictures and important information. 2. Change “5 Maintenance Requirement” to “5 Function and Performance Checking Method”, increase detailed information of checking. 3. Change “6 Checking” to “7 Care and Maintenance”, increase detailed information of maintaining. 4. Change “7 System Maintenance” to “6 System Software”, move the content of cleaning to the chapter 7. 5. Increase “Electrical Safety Inspection” normative description and delete original content of electrical safety.
13.0	2013.6.24	Add “The attentions to the assembly/disassembly, otherwise the hard disk will be damaged” to Chapter 4.3.14
14.0	2014.7.10	Section 4.2, add picture of the cable rubber cushion. Section 4.3.2, add picture of the rubber cushion and corresponding notices.

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⚠ Note ⚠

This equipment is not intended for family usage.

This equipment must be operated by skilled/trained medical professionals.

⚠ Warning ⚠

It is important for the hospital or organization that employs this equipment to carry out a reasonable service/maintenance plan. Neglect of this may result in machine breakdown or injury of human health.

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2. Freight policy: The customer is responsible for freight charges when this product is shipped to Mindray for service (this includes customs charges).
3. Return address: Please send the part(s) or equipment to the address offered by Customer Service department

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Safety Precautions

1. Meaning of Signal Words

In this operator's manual, the signal words ⚠**DANGER**, ⚠**WARNING**, ⚠**CAUTION** and **NOTE** are used regarding safety and other important instructions. The signal words and their meanings are defined as follows. Please understand their meaning before reading this manual.

Signal word	Meaning
⚠ **DANGER**	**Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.**
⚠ **WARNING**	**Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury.**
⚠ **CAUTION**	**Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury.**
NOTE	Indicates a potentially hazardous situation that, if not avoided, may result in property damage.

2. Meaning of Safety Symbols

Symbol	Description
	Type-BF applied part The ultrasound transducers connected to this system are Type-BF applied parts. The ECG module connected to this system is Type-BF applied part.
	"Attention" indicates the points that you should pay attention to. Be sure to read the operator's manual concerning these points before using the system.

3. Safety Precautions

Please observe the following precautions to ensure patient's and operator's safety when using this system.

⚠DANGER:	**Do not use flammable gasses, such as anesthetic gas, oxygen or hydrogen, or flammable liquids such as ethanol, near this system, because there is danger of explosion.**

⚠ WARNING:		
	1	**Connect the adapter power plug of this system and power plugs of the peripherals to wall receptacles that meet the ratings indicated on the rating nameplate. Using a multifunctional receptacle may affect the system grounding performance, and cause the leakage current to exceed safety requirements. You must use the power adapter provided with the system; otherwise electric shock may result.**
	2	**Use the printing cable provided with this system to connect the printer. Electric shock may result.**
	3	**Connect the grounding conductor before turning ON the system. Disconnect the grounding cable after turning OFF the system. Otherwise, electric shock may result.**
	4	**For the connection of power and grounding, follow the appropriate procedures described in this operator's manual. Otherwise, there is risk of electric shock. Do not connect the grounding cable to a gas pipe or water pipe; otherwise improper grounding may result or a gas explosion may occur.**
	5	**Before cleaning the system, disconnect the power cord from the outlet. System failure and electric shock may result.**
	6	**This system is not water-proof. Do not use this system in any place where water leakage may occur. If any water is sprayed on or into the system, electric shock may result. If water is accidentally sprayed on or into the system, contact Mindray Customer Service Department or sales representative.**
	7	**Store and use the transducers carefully. Do not use a transducer that has a damaged, scratched surface, or exposed wiring of any kind. Immediately stop using the transducer and contact Mindray Customer Service Department or sales representative.**
	8	**Do not allow the patient to contact the live parts of the ultrasound system or other devices, e.g. signal I / O ports. Electric shock may occur.**

9 **Do not use an aftermarket transducer other than those specified by Mindray. The transducers may damage the system causing a profound failure, e.g. a fire in the worst case.**

10 **Do not subject the transducers to knocks or drops. Use of a defective transducer may cause an electric shock.**

11 **Do not open the covers and front panel of the system. Short circuit or electric shock may result when the system hardware is exposed and powered on.**

12 **Do not use this system simultaneously with equipment such as an electrosurgical unit, high-frequency therapy equipment, or a defibrillator, etc.; otherwise electric shock may result.**

13 **If the grounding wire is questionable, you should disconnect the system from the supply power and stop using the adapter, and change the power supply to internal batteries.**

14 **Only use the ECG leads provided with the ECG module; otherwise electric shock may result.**

15 **When moving the system, you should first fold the LCD display, disconnect the system from other devices (including transducers) and disconnect the system from the power supply.**

16 **Accessory equipment connected to the analog and digital interfaces must comply with the relevant IEC standards (e.g., IEC 60950 information technology equipment safety standard and IEC 60601-1 medical equipment standard). Furthermore all configurations must comply with the standard IEC60601-1-1. It is the responsibility of the person, who connects additional equipment to the signal input or output ports and configures a medical system, to verify that the system complies with the requirements of IEC60601-1-1. If you have any questions regarding these requirements, consult your sales representative.**

17 **Prolonged and repeated use of keyboards may result in hand or arm nerve disorders for some individuals. Observe the local safety or health regulations concerning the use of keyboards.**

⚠ CAUTION:

1 Precautions concerning clinical examination techniques:

a) This system must be used only by qualified medical professionals.

b) This operator's manual does not describe clinical examination techniques. The clinician should select the proper examination techniques based on specialized training and clinical experience.

2 Malfunctions due to radio wave:

a) If a radio wave emitting device is used in the proximity of this system, it may interfere with operations. Do not bring or use devices that generate radio waves, such as cellular telephones, transceivers, and radio controlled toys, in the room where the system is installed.

b) If a person brings a device that generates radio waves near the system, ask him / her to immediately turn OFF the device.

3 Precautions concerning movement of the system:

a) When you place the system on the mobile trolley and move them together, you must secure all objects on the mobile trolley to prevent them from falling. Otherwise you should separate the system from the mobile trolley and move them individually.

When you have to move the system with the mobile trolley upward or downward the stairs, you must separate them first and then move them individually.

b) Object placed on the monitor may fall and injure an individual.

c) Fasten and fully secure any peripheral device before moving the system. A loose peripheral device may fall and injure an individual.

4 Do not expose the system to excessive vibration through transportation. Mechanical damage may result.

5 Do not connect this system to outlets with the same circuit breakers and fuses that control the current of devices such as life-support systems. If this system malfunctions and generates overcurrent, or when there is an instantaneous current at power ON, the circuit breakers and fuses of the building's supply circuit may be tripped.

6 **Always keep the system dry. Avoid transporting this system quickly from a cold place to a warm place; otherwise condensation or water droplets may form allowing a short circuit and possible electric shock.**

7 **If the circuit protector is tripped, it indicates that the system or a peripheral device was improperly shut down and the system is unstable. You cannot repair the system under this circumstance and must call the Mindray Customer Service Department or sales representative.**

8 **There is no risk of high-temperature burns during routine ultrasound examinations. It is possible for the surface temperature of the transducer to exceed the body temperature of a patient due to environmental temperature and exam type combinations. If a patient complains of any excessive heat from the transducer, immediately stop scanning. To prevent patient burns, ensure there is no surface damage to the transducer. Do not apply the transducer to the same region on the patient for a long time. Apply the transducer only for a period of time required for the purpose of diagnosis.**

9 **The system and its accessories are not disinfected or sterilized prior to delivery. The operator is responsible for the cleaning and disinfection of transducers and sterilization of biopsy brackets according to the manuals, prior to the use. All items must be thoroughly processed to completely remove harmful residual chemicals or gasses that are harmful to the human body or that may damage the accessory.**

10 **It is necessary to press [End Exam] to end the current scan that is in progress and clear the current Patient Information field. Otherwise new patient data may be combined with the previous patient data.**

11 **Do not connect or disconnect the system's power cord or its accessories (e.g., a printer or a recorder) without turning OFF the power first. This may damage the system and its accessories or cause electric shock.**

12 **Do not turn OFF the power supply of the system during printing, file storage or invoking other system operations. An interrupted process may not be completed, and can become lost or corrupted.**

	13	**If the system is powered off improperly during operation, it may result in data damage of the system's hard disk or system failure.**
	14	**Do not use the system to examine a fetus in the Doppler mode for a long period of time.**
	15	**Do not use a USB memory device (e.g., a USB flash drive, removable hard disk) which has unsafe data. Otherwise system damage may result.**
	16	**It is recommended to only use the video devices specified in this manual.**

NOTE:	1	Do not use the system in the vicinity of strong electromagnetic field (such as a transformer), which may affect the performance of the system.
	2	Do not use the system in the vicinity of high-frequency radiation source, which may affect the performance of the system or even lead to failure.
	3	To avoid damaging the system, do not use it in following environment: a) Locations exposed to direct sunlight; b) Locations subject to sudden changes in environmental temperature; c) Dusty locations; d) Locations subject to vibration; e) Locations near heat generators; f) Locations with high humidity.
	4	Turn ON the system only after the power has been turned OFF for more than 20 seconds. If the system is turned ON immediately after being turned OFF, the system may not reboot properly and could malfunction.
	5	Do not disconnect a transducer that remains in a live imaging state. This can damage the system and / or transducer. Press [Freeze] or turn off the power of the system before connecting or disconnecting a transducer.

6	Remove ultrasound gel from the face of a transducer when the examination is complete. Water in the gel may enter the acoustic lens and adversely affect or damage the transducer array and lens.
7	You should properly back up the system to a secure external storage media, including system configuration and settings and patient data. Data stored to the system's hard drive may be lost due to system failure, improper operation or accident.
8	Do not apply external force to the control panel. The system may be damaged.
9	If the system is used in a small room, the room temperature may rise. Provide proper ventilation and free air exchange.
10	To dispose of the system or any part, contact Mindray Customer Service Department or sales representative. Mindray is not responsible for any system content or accessories that have been discarded improperly.
11	To ensure optimal system operations, it is recommended that you maintain the system under a Mindray service agreement. Various aspects of system performance and operation can be maintained under the professional supervision of a service representative.
12	The iScape feature constructs a single extended image from a series of individual image frames. The quality of the final image is user-dependent and requires skill to efficiently apply the feature and technique. Exercise caution when measurements are performed from an iScape image.
13	Ensure that the current exam date and time are the same as the system date and time.

4. Warning Labels

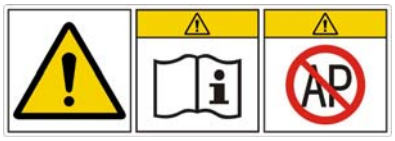
The warning labels are attached to this system in order to call your attention to potential hazards.

The symbol ⚠ on the warning labels indicates safety precautions. The warning labels use the same signal words as those used in the operator's manual.

Refer to the operator's manual for detailed information about the warning labels. Read operator's manual carefully before using the system.

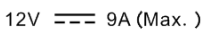
The name, pattern and meaning of each warning label are described as follows:

No.	Label	Meaning

<1>	 a) b) c)	a) Before using the system, be sure to carefully read the relevant content of this operator's manual. b) Do not place any object on the keyboard; beware of excessive stress exerted to the keyboard; fold the keyboard when moving the system. c) DANGER: There is explosion risk if the system is used with flammable anesthetics.
<2>	The following labels are available when the system works with the mobile trolley. a) b) c)	a) Before using the system, be sure to carefully read the relevant content of this operator's manual. b) CAUTION: Do not place the system with the mobile trolley on a sloped surface. Otherwise the system may slide, resulting in personal injury or the system malfunction. Two persons are required to move the system over a sloped surface. c) CAUTION: Do not sit on the system.

5. Symbol Explanation

Symbol	Name	Function
	ON/OFF	Power button
	ETHERNET	Network port
	PARALLEL	Parallel port
	SERIAL	Serial port
	REMOTE	Remote control port
	USB	USB port
	AUDIO	Audio signal
	S-VIDEO VIDEO	S-VIDEO signal interface VIDEO signal interface

	VGA RGB	VGA signal RGB signal
	PROBE	Transducer port
	Mic	Microphone input jack
	IO extend	IO extend port
	/	Battery status indicator
	/	Battery installation position indicator
	/	Pencil probe port
	/	Locking a transducer
	/	Unlocking a transducer
	/	Connecting power supply
	/	Power adapter port
	/	Product serial number
	/	Manufacture date

1 System Overview

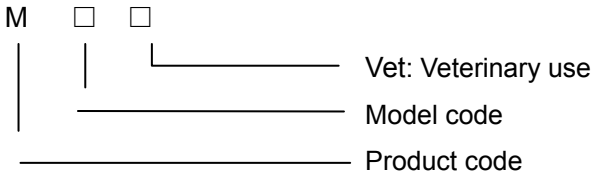
1.1 Intended Use

The M5/M5T system is intended for use in ultrasound exams for human.

There is one difference between M5T and M5, that is, M5 has a pediatric measurement package, but M5T does not.

The M5Vet system is intended for use in ultrasound exams for animals.

1.2 Product and Model Code



2 Introduction

2.1 Introduction of Unit

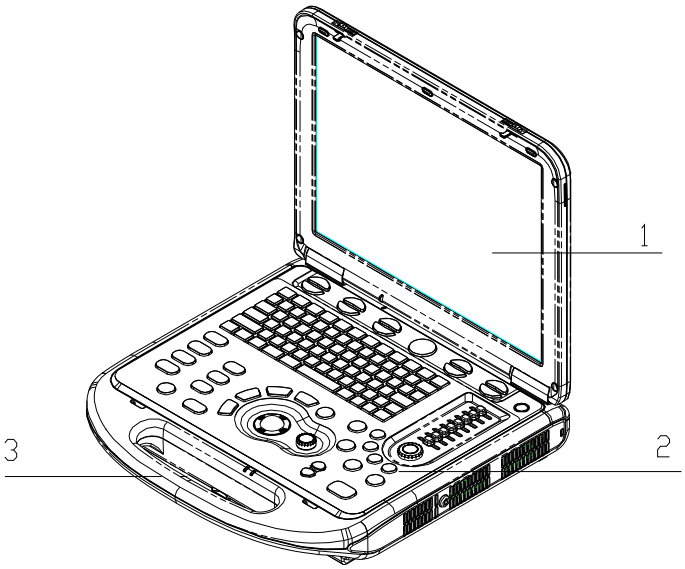


Figure 2-1 Appearance (1)

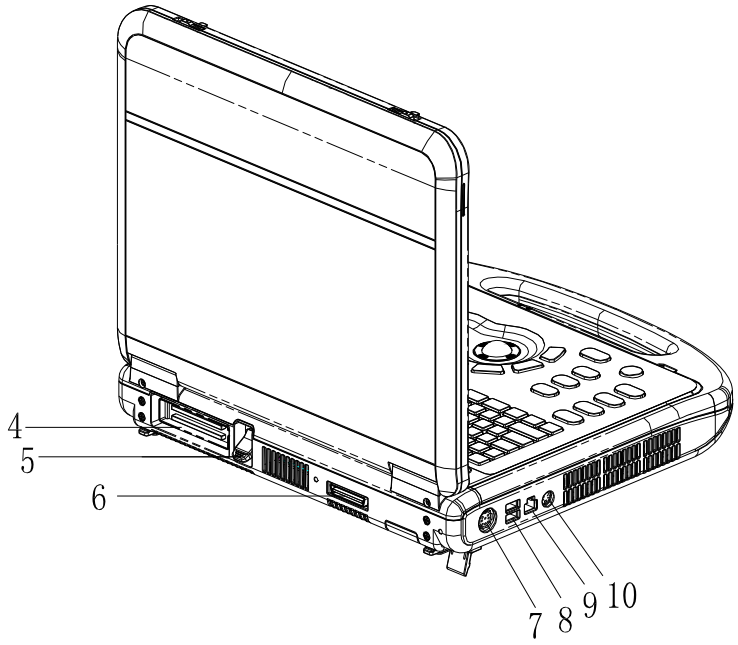


Figure 2-2 Appearance (2)

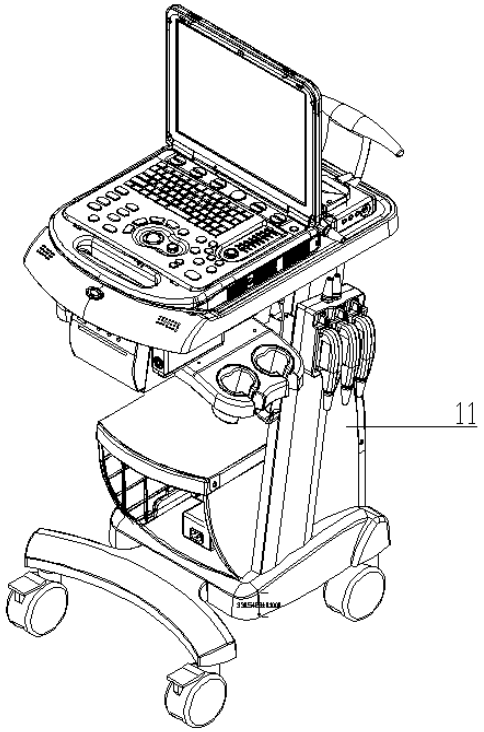


Figure 2-3 Appearance (3)

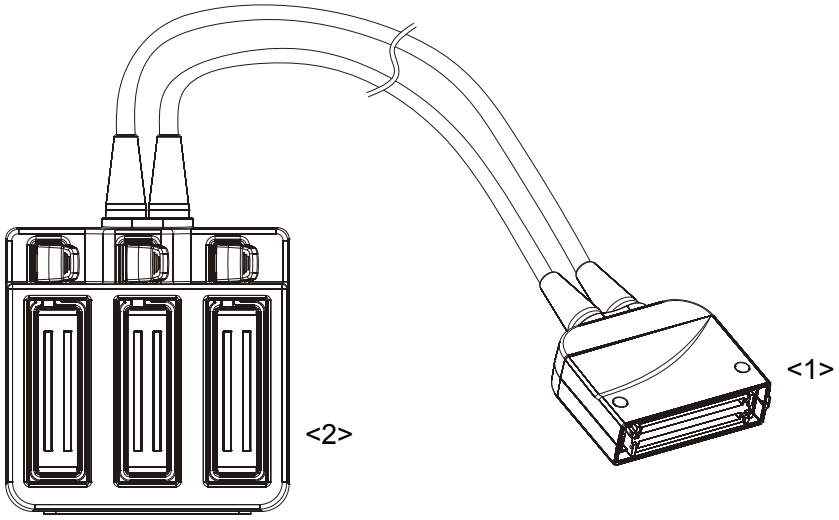
No	Name	Function
1	Monitor	Displays the images and parameters during scanning
2	Control panel	Operator-system interface or control
3	Handle	Used for carrying the system
4	Transducer port	Connects a transducer to the main unit; or connects a probe extend module
5	Transducer locking lever	Locks or unlocks the transducer connected with the main unit : locking symbol : unlocking symbol
6	IO extend port	Connects the IO extend module
7	Power input port 12V ⎓ 9A (Max.)	Connects the power adapter
8	USB port	Connects USB devices
9	Network port	Connects the network
10	S-Video separate video output	Connects VCR recorder or video printer
11	Mobile trolley	Optional device, used for placing the ultrasound system and extend modules

2.2 Extend Modules

There are four extend modules available for the system:

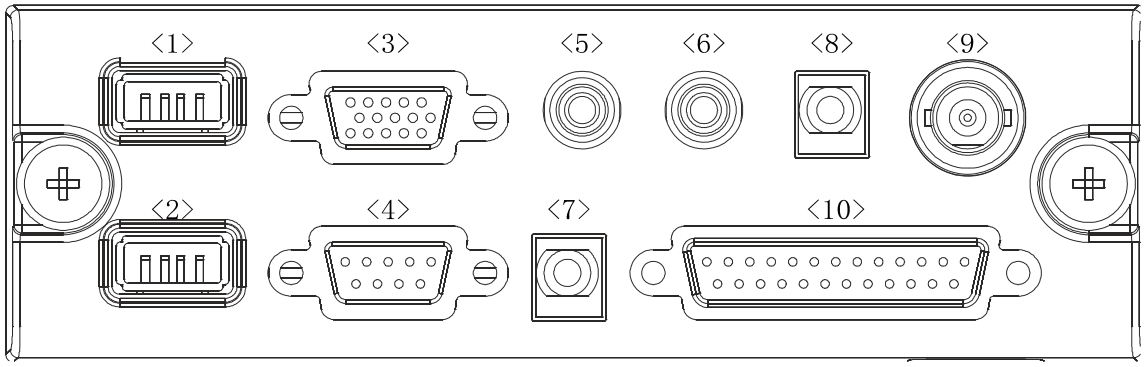
- Probe extend module
- IO extend module
- V/A extend module
- ECG module

- **Probe Extend Module**



No	Name	Function
<1>	Connector	Connects to the transducer port of the main unit
<2>	Transducer ports	Extended ports for connecting two live transducers; the middle one is a docking port

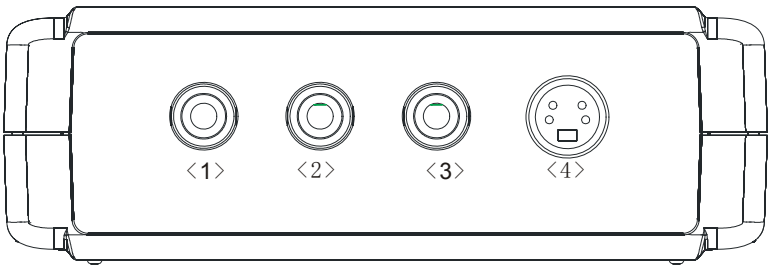
IO Extend Module



No	Name & Symbol	Function
<1>, <2>	USB port	Connects USB devices.
<3>	VGA output port	Connects a display or projector
<4>	Serial port	Connects serial port devices
<5>, <6>	Audio output port	Used for audio signals of PW sound from DVD output or audio comments
<7>	Mic In port	Reserved (Connects a microphone used for receiving audio comments when a recorder is used to record images)
<8>	Remote control port	Connects the control port of the video printer
<9>	Composite video output port	Used for receiving the output image signal of the video printer or recorder
<10>	Parallel port	Reserved. (Connects the parallel port devices)

- **V/A Extend Module**

The module is connected to the USB port of the main unit via a USB cable.

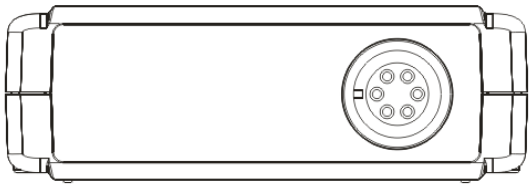


No	Name	Function
<1>	Audio input port	Used for audio signal input

<2>	Audio input port	Used for audio signal input
<3>	Composite video input port	Used for composite signal video input
<4>	Separate video input port	Used for separate signal video input

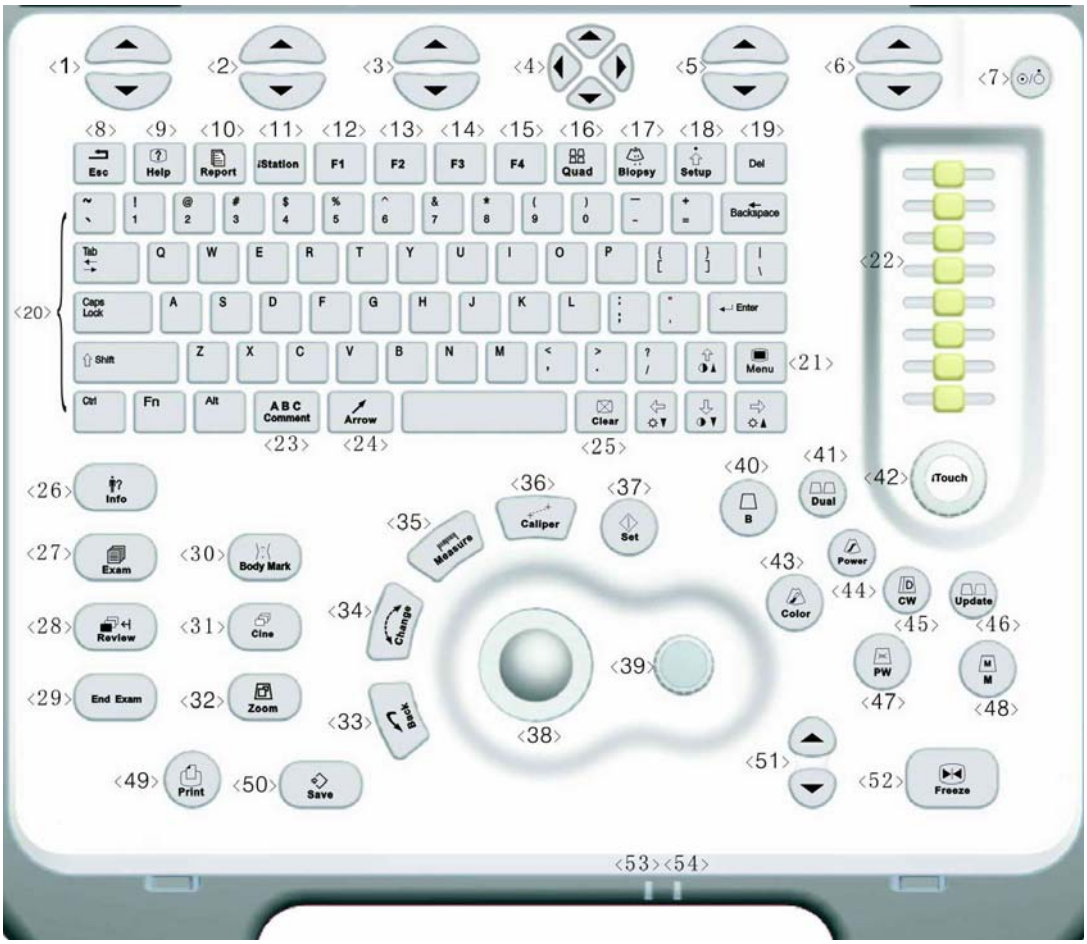
- **ECG Module**

The module is connected to the USB port of the main unit via a USB cable.



Name	Function
ECG lead port	Used for ECG signal input

2.3 Control Panel



No	English Name	Name Description	Function
<1>	/	soft menu controls 1	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<2>	/	soft menu controls 2	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<3>	/	soft menu controls 3	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<4>	/	soft menu controls 4	Up / down controls are used to turn pages up / down when there are more-than-one pages for the soft menu; Left / right controls are used to switch between the exam types.

<5>	/	soft menu controls 5	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<6>	/	soft menu controls 6	Press to select the soft menu items displayed on the bottom of the screen. Refer to the subsequent contents for specific functions.
<7>	/	Power button	When you press the power button to turn on the system, the system enters the work status and the indicator lights on and becomes green. When the system enters the standby status, the indicator turns yellow. When you press the power button to turn off the system, the indicator lights off.
<8>	Esc	Escape	Press to exit the current status to the previous status.
<9>	Help	Help	Press to open or close the accompanying help documents.
<10>	Report	Report	Press to open or close the diagnosis reports.
<11>	iStation	/	Press to enter or exit the patient information management system.
<12>	F1	User-defined key	You can assign a function to the key.
<13>	F2	User-defined key	You can assign a function to the key.
<14>	F3	User-defined key	You can assign a function to the key.
<15>	F4	User-defined key	You can assign a function to the key.
<16>	Quad	4-split screen display	Press to enter or exit the 4-split screen display.
<17>	Biopsy	Biopsy	Press to show or hide the biopsy guide line.
<18>	Setup	Setup	Press to show or hide the Setup menu.
<19>	Del	Delete	Press to delete the comment, etc.
<20>	/	Alphanumeric keys	Same as those of PC.
<21>	Menu	Menu	Press to display a mode-specific parameter menu and / or access other system selections.

<22>	TGC	Time Gain Compensation	Move to adjust time gain compensation.
<23>	Comment	Comment	Press to enter or exit the character comment status.
<24>	Arrow	Arrow	Press to enter or exit the arrow comment status.
<25>	Clear	Clear	Press to clear the comments or measurement calipers on the screen.
<26>	Info	Patient information	Press to enter the patient information input screen.
<27>	Exam	Exam type	Press to switch between exam types.
<28>	Review	Review	Press to review the image files stored.
<29>	End Exam	End exam	Press to end an exam.
<30>	Body Mark	Body mark	Press to enter or exit the Body Mark status.
<31>	Cine	Cine review	Press to enter or exit the Cine Review status.
<32>	Zoom	Zoom	Press to enter or exit the Zoom status.
<33>	Back	Return or delete	Press to return to the previous operation or delete the previous item.
<34>	Change	Change	Press to toggle between calipers within the same measurement.
<35>	Measure	Measure	Press to enter or exit the application measurement mode.
<36>	Caliper	Caliper	Press to enter or exit the general measurement mode.
<37>	Set	Set	Press to confirm an operation, same as the left-button of the mouse.
<38>	/	Trackball	Roll the trackball to move the cursor position.
<39>	/	Multifunction knob	Rotate to adjust image parameters or comment arrows.
<40>	B	/	Press to enter the B mode
<41>	Dual	/	Press to enter the Dual mode from another mode; Press to switch between the two display windows in the Dual mode.
<42>	iTouch	/	Rotate to increase or decrease the image gain; press to optimize the image, serving as a one-key optimization.

<43>	Color	/	Press to enter the Color mode.
<44>	Power	/	Press to enter the Power mode.
<45>	CW	/	Reserved for the CW mode.
<46>	Update	/	Press to change the current window if there are more-than-one windows.
<47>	PW	/	Press to enter the PW mode.
<48>	M	/	Press to enter the M mode.
<49>	Print	Print	Press to print the contents which are set.
<50>	Save	Save	Press to save the single-frame images in the preset format.
<51>	Depth	Depth	Press to increase or decrease the imaging depth.
<52>	Freeze	Freeze	Press to freeze or unfreeze onscreen image.
<53>	/	Indicator 1	Indicates if the main unit is connected to the power supply. When the main unit is not connected to the power supply, the indicator light is off. When the main unit is connected to the power supply, the indicator light is on and in green color.
<54>	/	Indicator 2	Indicates the current status of the batteries. When the system is supplied with power by the batteries and the power capacity is lower than 30%, the indicator is yellow and flashes. When the batteries are being charged, the indicator light is on and in yellow color. When the battery capacity is charged to the full capacity, the indicator color changes from yellow to green. In other statuses, the indicator light is off.

There are five keys which can work with the Fn key:

Key Name	Function
[Fn] +	Press the two keys to increase the brightness of the LCD display.

[Fn] +	Press the two keys to decrease the brightness of the LCD display.
[Fn] + [S]	Press the two keys to mute the speaker.
[Fn] +	Press the two keys to increase display contrast.
[Fn] +	Press the two keys to decrease display contrast.

3 Principle Description

3.1 Electric Principle of the System

The M5 system is a compact color ultrasound imaging system. Its schematic diagram is shown in Figure 3-1

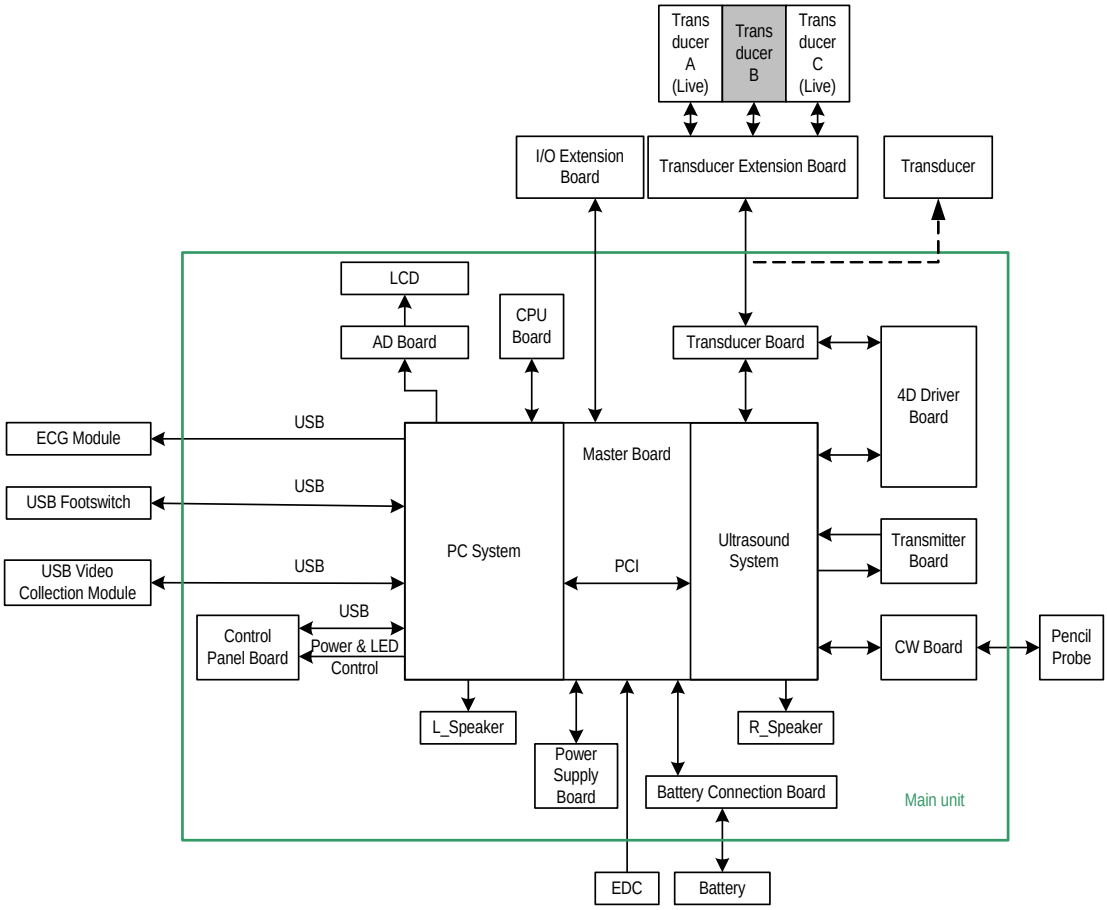


Figure 3-1 Schematic Diagram

The M5 system consists of main unit, peripheral extension modules and power system. The main unit contains the following parts.

- Master Board:

ultrasound system: used for ultrasound echo reception, amplification, sampling, beam forming, signal processing, ultrasound scan receiving control and data communications between PC system.

PC system: used for post processing of echo data, interaction with the user, and supporting peripherals.

Power management and filter system: used for ensuring normal work of system power, supporting normal turn-off, standby and dormant status.

In addition, the Master Board provides connecting ports for modules.

- Transmitter Board: used for delay focusing transmission.
- Control Panel Board: used for communicating with the Master Board via USB port, supporting keyboard control before the PC system is initiated.
- CPU Board: used for PC system
- Transducer Board: used for connecting transducers or transducer extension module.
- 4D Driver Board (reserved)
- CW Board: used for analog CW signal processing and pencil probe signal processing.

The extension modules include:

- Transducer Extension Board: used for supporting 3 transducer ports; only two of them are live.
- I/O Extension Board
- USB ECG Module
- USB Footswitch
- USB Video Capture Module: used for video collection via USB port.
- L_Speaker & R_Speaker: left speaker and right speaker.

Power system (including power management and filter system on the Master Board):

- Power Supply Board: used for supplying power for the ultrasound system.
- Battery Connection Board
- Battery
- EDC(External Direct Current): external power adapter.

3.2 Principle of Boards

3.2.1 Power System

3.2.1.1 Basic Functions

The power system is used to supply power for the ultrasound system, and it consists of power adapter, batteries, battery connection board, main and auxiliary power boards. The power is supplied through two methods, external power adapter or batteries. The system is first powered by the adapter, and the batteries are provided for back-up. The main and auxiliary power boards are used to provide direct current output and charging management.

Table 3-1 DC Power Output

No	Output	Name of Boards	Remark
1	+12V	Main power board	controlled by power_on signal
2	5Vstb	Main power board	Output for all time
3	5Vstb_CPU	Main power board	controlled by 5Vstb_CPU_EN signal

4	+5V	Main power board	controlled by power_on signal
5	+3.3V	Main power board	controlled by power_on signal
6	THV	Main power board	controlled by power_on signal
7	+2.5V	Auxiliary power board	controlled by power_on signal
8	+1.5V	Auxiliary power board	controlled by power_on signal
9	-5V	Auxiliary power board	controlled by power_on signal
10	-12V	Auxiliary power board	controlled by power_on signal

3.2.1.2 Principle of Power System

As shown in Figure 3-2, after the batteries and adapter are connected to the system main board, the main power board is connected through a 64-pin socket, generating outputs of +12v, +5v, 5Vstb, 5Vstb_cpu, +3.3V, and THV. The Vbus+, +5v, and EDC_Power signals are inputted to the auxiliary power board through the main power board via the 26-pin socket. In the auxiliary power board, the -12V, -5V, +2.5V, and +1.5V are obtained, and charging management is implemented.

The 64-pin socket and 26-pin socket signal definitions are shown in Table 3-2 Signal Definition of Connectors between Main Power Board and System Main Board and Table 3-3 Signal Definition of Connectors between Main Power Board and Auxiliary Power Board.

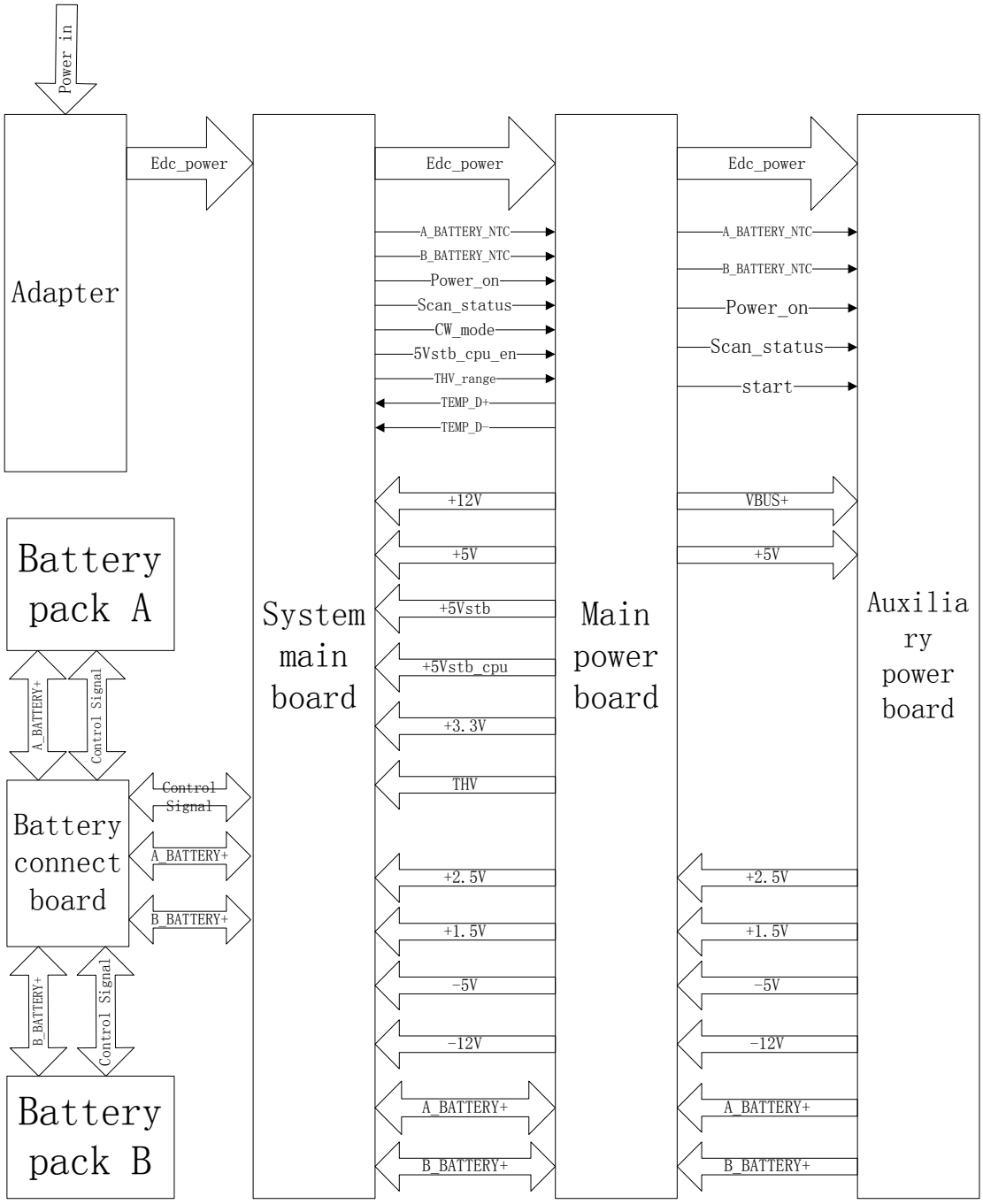


Figure 3-2 Schematic Diagram of Power System

Table 3-2 Signal Definition of Connectors between Main Power Board and System Main Board

Pin No.	Name	Pin No.	Name
1	EDC_Power	2	EDC_Power
3	EDC_Power	4	EDC_Power
5	GND	6	GND
7	GND	8	GND

9	A_Battery+	10	A_Battery+
11	A_Battery-	12	A_Battery-
13	B_Battery+	14	B_Battery+
15	B_Battery-	16	B_Battery-
17	Gnd	18	Gnd
19	A_Battery_NTC	20	B_Battery_NTC
21	EDC_Status	22	Power_ON
23	Gnd	24	Scan_Status
25	Temperature_D+	26	CW_Mode
27	Temperature_D-	28	+5VStb_CPU_En
29	Gnd	30	Gnd
31	+5VSTB	32	+5Vstb_CPU
33	+12V	34	+12V
35	GND	36	GND
37	GND	38	GND
39	-5.3V	40	-12V
41	Gnd	42	Gnd
43	+5V	44	+5V
45	Gnd	46	Gnd
47	+2.5V	48	+2.5V
49	Gnd	50	Gnd
51	Gnd	52	+1.5V_Feedback
53	+1.5V	54	+1.5V
55	Gnd	56	Gnd
57	+3.3V	58	+3.3V
59	Gnd	60	Gnd
61	Gnd	62	Gnd
63	THV	64	THV_Range

Table 3-3 Signal Definition of Connectors between Main Power Board and Auxiliary Power Board

Pin No.	Name	Pin No.	Name
1	GND	2	-5.3V
3	Scan_status	4	-12V
5	Power_on	6	+2.5V
7	B_Battery_NTC	8	+2.5V
9	A_Battery_NTC	10	Gnd
11	Gnd	12	Gnd
13	B_Battery+	14	1.5V_feedback

15	A_Battery+	16	+1.5V
17	Edc_power	18	+1.5V
19	GND	20	GND
21	GND	22	GND
23	Vbus+	24	+5VL
25	GND	26	Start

3.2.1.3 5vstb Circuit Unit

1.1.1.1.1. Principle of 5vstb

The relation between the adapter output Edc_power and battery output batt is “OR”. After “Edc_power” or “batt”, as being input of 5vstb, goes through the linear stablizing chip MIC5202-5.0YMS, the 5vstb is obtained.

The overcurrent and overtemperature protection is implemented in MIC5202-5.0YMS.

1.1.1.1.2. Service Points for 5vstb

If the 5vstb unit is faulty, first check if the input voltage of U9 PIN1 is normal; if normal, it indicates that the U9 is damaged or the fault is caused by the overcurrent or shortcircuit of the load.

3.2.1.4 +12v circuit unit

1.1.1.1.3. Principle of +12v

The rise-and-fall voltage chip LTC3780EG#PBF made by Linear company is adopted for the +12v circuit unit. Whether the input voltage is lower or higher than 12v, the output voltage is stablized at 12v.

The +12v overcurrent and overvoltage protection is not locked, and the overcurrent is between 6.5A and 9.5A. The output voltage returns to normal after overcurrent disappears.

1.1.1.1.4. Service Points of +12v

Before testing, ensure that the power_on signal is low level and the input voltage VBUS+ is normal.

The work flow of service is shown as follows:

- Measure the level of U3 PIN8, which should be higher than 4V;
- Measure the level of U3 pin19, which should be about 6v;
- Use an oscilloscope to measure G poles of Q11, Q18, Q24 and Q25 to check if there is drive pulse; at least two MOSs’ G poles have drive pulse;
- Check if four MOSs’ Q11, Q18, Q24 and Q25 and diode D5 and D7 are damaged.

3.2.1.5 Circuit Units of +5v and +3.3v

1.1.1.1.5. Principle of +5v and +3.3v

The implementations of +5v and +3.3v are the same. The chip LTM4600 made by Linear company is adopted for the two circuit units. This chip is a step-down and synchronous-rectification IC, and it is incorporated with two MOS semiconductors and power inductor.

LTM4600 is incorporated with overcurrent protection.

1.1.1.1.6. Service Points of +5v and +3.3v

Before testing, ensure that +12v output is normal and the input voltage VBUS+ is normal.

The work flow of service is shown as follows:

- Test PIN23, which should be high level;
- Check if R6 (+3.3v unit) and R12 (+5v unit) are well soldered;
- Check if the soldering position IC is proper, if not, it will cause short circuit of pins at the bottom of the IC.

3.2.1.6 THV Circuit Unit

1.1.1.1.7. Principle of THV

THV consists of a step-down circuit and a step-up circuit. The step-down circuit outputs 5～10v (the voltage value is controlled by THV_range, 0v corresponding to THV's 5v, 4v corresponding to THV's 10V). The step-up circuit outputs 20～140v (the voltage value is controlled by THV_range, 0v corresponding to THV's 20v, 4v corresponding to THV's 140V). The step-down circuit is always at the working status. The step-up circuit is controlled by cw_mode; when the cw_mode is low, the step-up circuit is at the working status.

The step-down control chip u10 is TPS54350, incorporating a MOS semiconductor.

The step-up control chip U2 is TL594. Between the step-up circuit input and +12v is P-MOS semiconductor U6.

The step-down circuit does not have overvoltage protection. The step-up circuit (20V～140V) has overvoltage protection, and the overvoltage point is about 170v; the overvoltage is not locked; when overvoltage occurs, the voltage remains at about 170v.

The step-up and step-down circuits both have overcurrent protection respectively, so when either has overcurrent, both circuits will stop working and be locked.

1.1.1.1.8. Service Points of THV circuit unit

Before testing, ensure that +12v output is normal and negative pressure output of U1 is normal.

The low voltage circuit and high voltage circuit are independent. First confirm whether overcurrent or shortcircuit causes thv circuit protection by means of ocp signal (when overcurrent occurs, the ocp signal is high level). After you confirm it is not caused by overcurrent or shortcircuit, check if it is caused by failure of low voltage circuit or high voltage circuit.

If it is caused by low voltage circuit, check if U10 (TPS54350), U7, D1, R142, or R143 works normally.

If it is caused by high voltage circuit, check if U6 (TL594), U2, Q5, D9, R110, or R111 works normally.

The work flow of troubleshooting for U10 and its peripheral circuit is shown as follows:

- Test PIN7, which should be higher than 0.5v;
- Test PIN12, which should be about 8v;
- Test PIN16, which should be 8v higher than the voltage of PIN15;
- Test PIN14 and PIN15, which should have pulse voltage waveform.

The work flow of troubleshooting for U6 and its peripheral circuit is shown as follows:

- Before testing, ensure that the cw_mode is low level, that is, the system is at the status of high voltage circuit;
- Test PIN8 and PIN11, which should be 12v;

- Test PIN14, which should be +5v;
- Test PIN5, which should have oscillating waveform;
- Test PIN15, which should be about 1.6v;
- Test PIN9 and PIN10, which should have drive pulse.

3.2.1.7 Circuit Units of +2.5v and +1.5V

1.1.1.1.9. Principle of +2.5V and +1.5V

The implementations of +2.5v and +1.5v are the same. The synchronous rectification and step-down chip EL7566 is adopted for both circuits. This chip is reliable and has low fault rate.

The EL7566 is incorporated with overcurrent protection, and is not locked when overcurrent occurs. After the overcurrent disappears, output returns to normal.

1.1.1.1.10. Service Points of +2.5V and +1.5V

Before power on, check if peripheral devices of EL7566 are well soldered, and check if the pins of EL7566 are well soldered or short circuited.

After power on, refer to the work flow shown as follows:

- Test PIN19～PIN21, which should be +5V;
- Test PIN22, which should be +5V;
- Test PIN27, which should have oscillating waveform;
- Test PIN8～PIN13, which should have pulse voltage waveform.

3.2.1.8 Circuit Units of -5v and -12V

1.1.1.1.11. Principle of -5V and -12V

The implementations of -5V and -12V are the same. The negative pressure Max1847 is adopted for both circuits. The -5V and -12v both have overvoltage and overcurrent protection circuits, so when either has overvoltage or overcurrent, both circuits will be off and locked.

1.1.1.1.12. Service Points of -5V and -12V

Ensure that VBUS+ for -5V and -12v is within normal range.

After power on, refer to the work flow shown as follows:

- Test the PIN15 of power chip, and its voltage should be the same as that of VBUS+;
- Test PIN5 of reference voltage, which should be 1.25V;
- Test PIN8 of overvoltage and overcurrent protection, which should be higher than 0.5v;
- Test PIN14 of the drive, which should have drive pulse output.

3.2.1.9 Charging Unit

1.1.1.1.13. Principle of Charging Unit

The rise-and-fall charging chip max1870 made by Maxim is adopted for both charging units A and B.

The max1870 enbling is controlled by the system’s main board and battery’s temperature, and eventually controlled by level of PIN15. When PIN15 is high level (about 5v) the charging is enabled; when PIN15 is low level, the charging is not enabled.

1.1.1.1.14. Service Points of Charging Unit

Before testing, ensure that the charging chip is enabled, that is, PIN15 is high level.

The work flow is shown as follows:

1. Check if the soldering position departs from normal position, if so, it will cause short circuit of pins.
2. Test power supplying voltage PIN32, which should be equal to adapter's output voltage of edc_power.
3. Test reference end's PIN2, which should be about 4.0v.
4. Test linear stabilizing output PIN1, which should be 5.4V.
5. Test drive's PIN27 and PIN22, at least either PIN has drive pulse output.
6. Test if the power device MOS semiconductor and diode are damaged.

3.2.2 Principle of Main Board

The schematic diagram of the main board is shown in Figure 3-3.

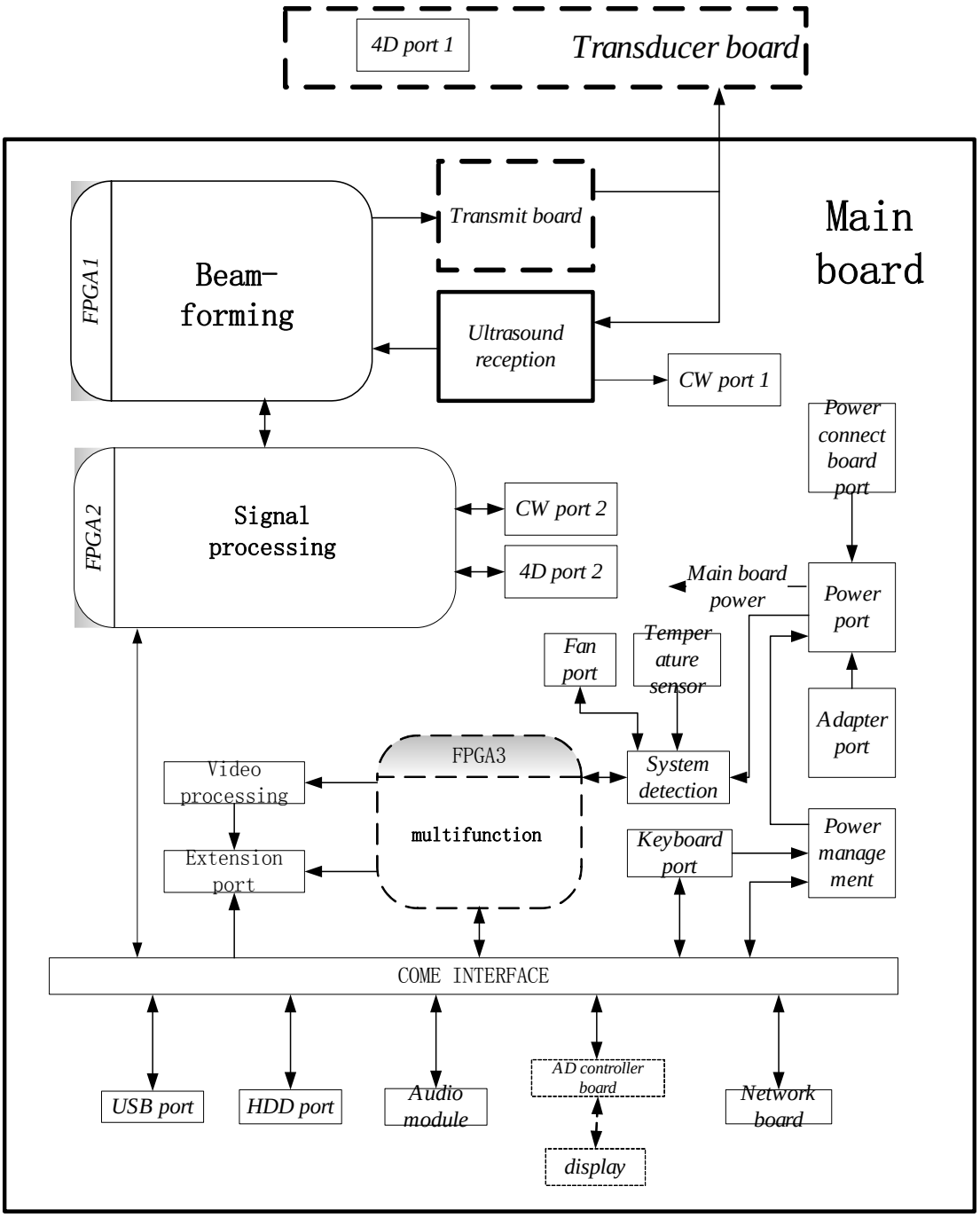


Figure 3-3 Schematic Diagram of Main Board

From the Figure 3-3, you can see that the main board consists of the following modules:

- Ultrasound reception
- Signal processing
- Power management
- System detection
- Video processing
- Back-end interface

The main board provides the interfaces for:

- Transducer board
- Transmit board
- CW board
- 4D board
- keyboard
- battery connecting board
- CPU module
- AD controller board
- power board
- HDD
- reserved power interface
- reserved signal interface
- fan
- speaker

External interfaces include:

- S_Video
- network
- USB (two)
- Extension interface

The above-mentioned module interfaces in the main board are shown in Figure 3-4.

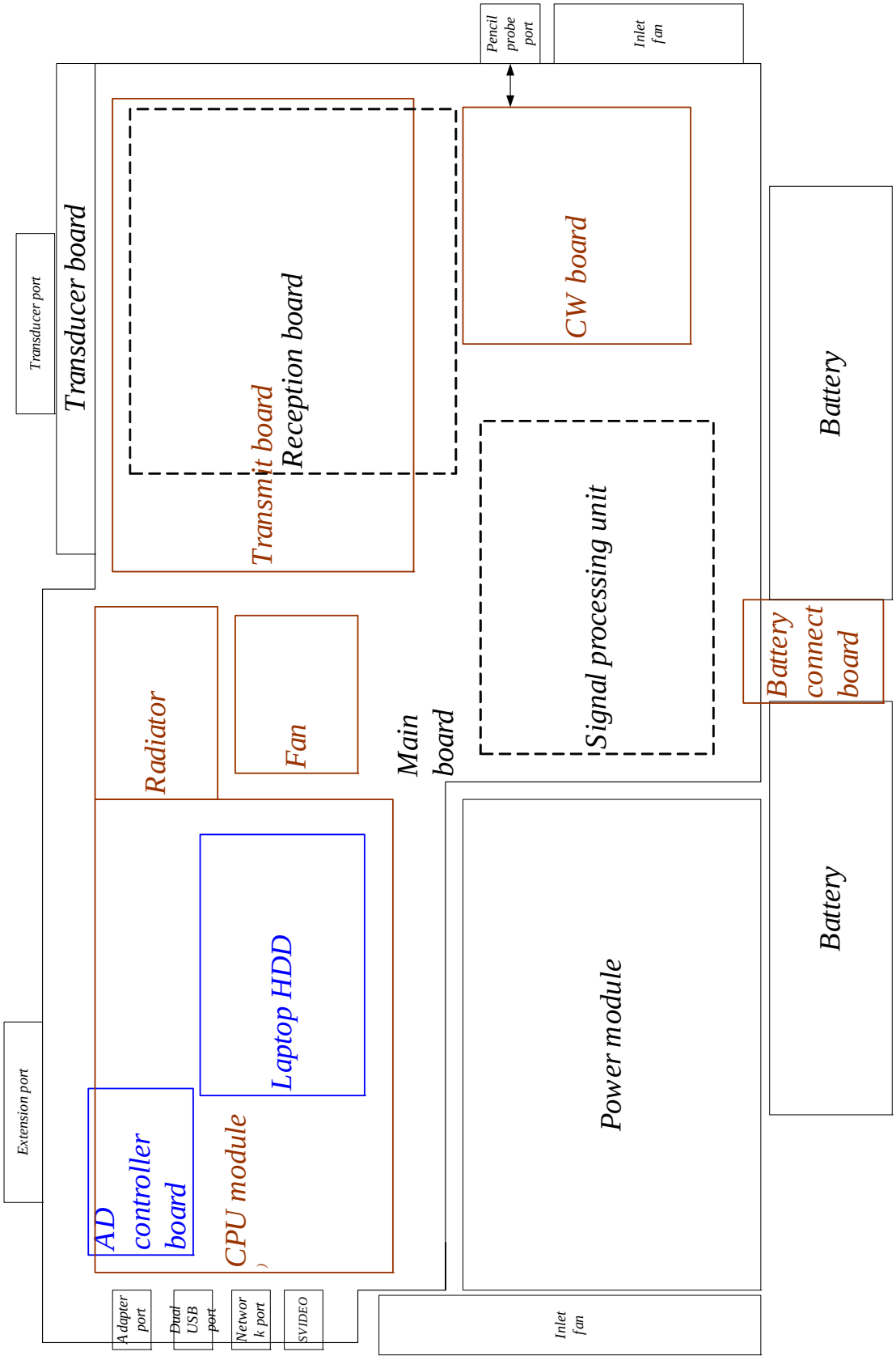


Figure 3-4 Module interfaces of Main Board

3.2.2.1 Power Distribution

M5's power distribution is a big network. Refer to Figure 3-5 Power Distribution for reference.

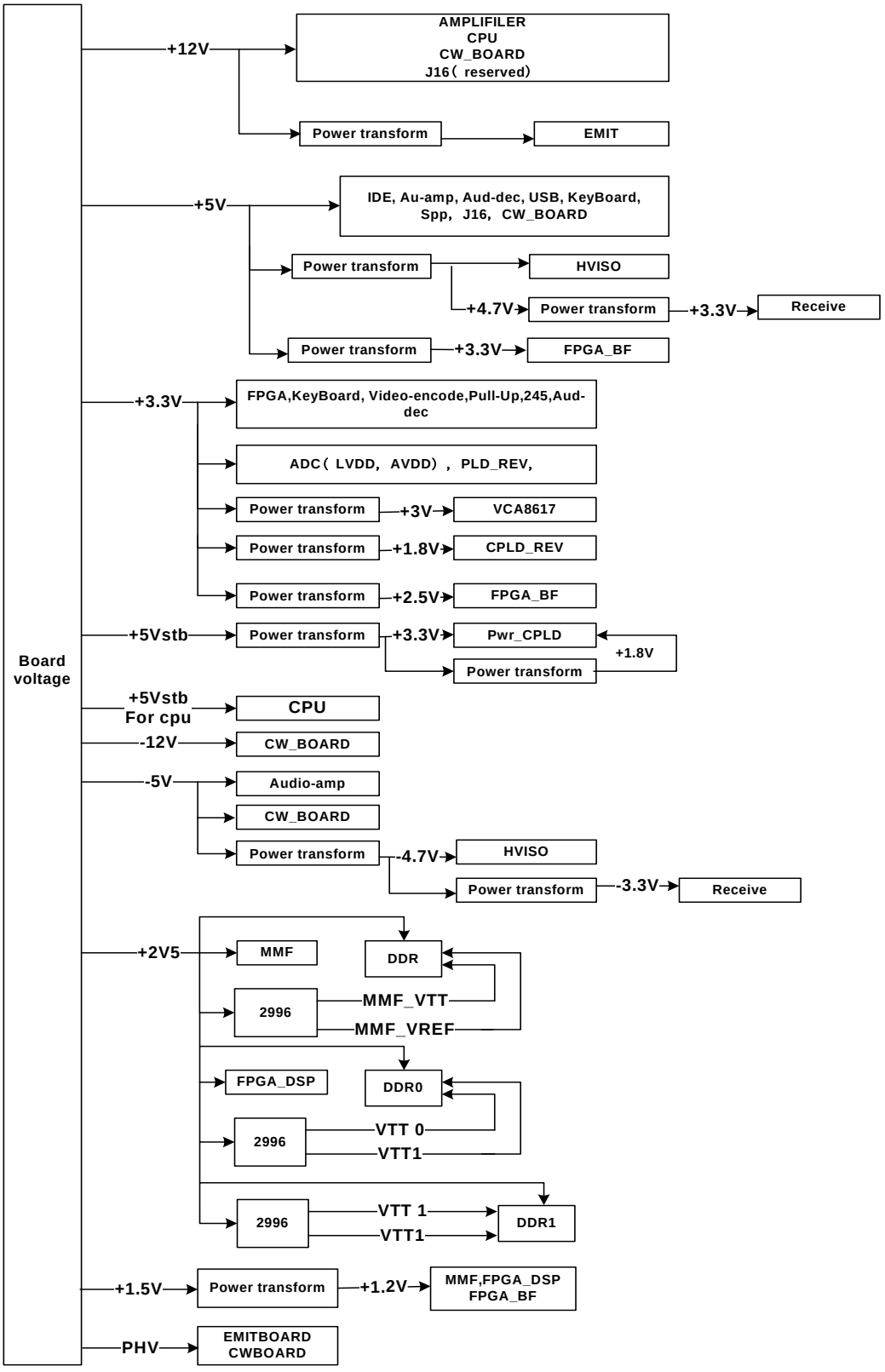


Figure 3-5 Power Distribution

3.2.2.2 Ultrasound Reception

The ultrasound reception consists of high voltage isolation and reception channel selection, voltage-controlled gain amplifier and ADC. The reception channel selection is implemented through two CPLDs. The analog control voltage of the voltage-controlled gain amplifier is derived from a DAC, and the SPI control signals of DAC and amplifier are both derived from FPGA1, likewise the ADC's SPI control signal is derived from FPGA1.

3.2.2.3 Signal Processing

The signal processing is implemented through two FPGAs: FPGA1 and FPGA2.

The FPGA1 implements control of the front-end chips (such as channel selection CPLD, VGA gain control DAC, ADC, transducer and transducer extension module), generation of transmission sequence pulse, beamforming, and orthogonal demodulation.

The FPGA2 implements signal processing, data uploading, loading of real time scan parameters, and data uploading through PCI interface.

3.2.2.4 Power Management

Power management is implemented by the power management CPLD.

System power consists of STANDBY power, CPU STANDBY power and normal working power in terms of power-on sequence.

STANDBY power is provided in the status of system POWER DOWN, including +5VSTB, +3V3STB and +1.8VSTB. STANDBY power is provided for the power management devices, including power management CPU, such as comparator generating POWER OK, 6M crystal oscillator, power management CPLD, power drive and status drive 244. As long as the adapter is connected or the batteries are loaded, the system will supply the STANDBY power.

CPU STANDBY power is required in the POWER DOWN status of PC module (+5VSTB_CPU). In the system POWER DOWN status, this power is turned off. However, before the PC system is activated, this power is turned on.

The working power is provided when the system is working normally. Except the two types of powers mentioned above, other powers all belong to working powers. The following indicators are used for the working powers:

Table 3-4 Power Indicators in M5 Main Board

No.	LED Code	Indication
1	D7	12V indicator
2	D25	3.3V indicator
3	D26	5V indicator

There are three indicators on the control panel, used for indicating power status, as shown in the following table.

Table 3-5 Indicators in the Control Panel

No.	Indicator	Definition
1	Work Status LED (this LED indicator is below the power button)	Indicates the current status of the main unit: It does not illuminate when the system is turned off; Press the power button, green light flickers before CPU initiates. The indicator stops flickering in green after CPU initiates.
2	EDC Status LED	Single-color, indicating if the main unit is connected to the

		mains power: If not connected, the indicator does not illuminate; If connected, the indicator illuminates in green color.
3	Battery Status LED	Dual-color, indicating the current status of the batteries: It does not illuminate if there is no battery inside; It illuminates in orange color when batteries are charging; It illuminates in green color when batteries are charged to full capacity; It flickers in orange color if batteries capacity is less than 30%.

3.2.2.5 System Detection

The system detection includes voltage detection, temperature detection, fan blocking detection, and fan rotating control.

Voltage detection: direct measurements, including 12V, VCC (+5V), VDD (+3.3V), 2.5V, 1.5V, PHV, A+3, -5V, and -12V.

It detects power board and front-end temperature.

It detects and controls all fans and motors.

3.2.2.6 Video Processing

After the video signal from the PC module output is processed by FPGA3 and video encoding chip, standard S_Video and Video signal are obtained.

3.2.2.7 Back-end Interfaces

The back-end interfaces refer to external interfaces.

3.2.2.8 Interfaces of Main Board

1.1.1.1.15. Interfaces of Main Board and Transducer Board

The interface signals of the main board and transducer board are defined in the following tables.

Table 3-6 Interfaces of Main Board and Transducer Board

CON1						CON2					
PIN	PIN NAME	PIN	PIN NAME	PIN	PIN NAME	PIN	PIN NAME	PIN	PIN NAME	PIN	PIN NAME

1	GND	2	PE1	3	GND	1	PE69	2	PE70	3	PE71
4	PE2	5	GND	6	PE3	4	PE72	5	PE73	6	PE74
7	GND	8	PE4	9	PE5	7	PE75	8	GND	9	PE76
10	PE6	11	PE7	12	GND	10	GND	11	PE77	12	PE78
13	PE8	14	GND	15	PE9	13	PE79	14	PE80	15	GND
16	GND	17	PE10	18	PE11	16	PE81	17	GND	18	PE82
19	PE12	20	PE13	21	GND	19	GND	20	PE83	21	PE84
22	PE14	23	GND	24	PE15	22	PE85	23	PE86	24	GND
25	GND	26	PE16	27	PE17	25	PE87	26	GND	27	PE88
28	PE18	29	PE19	30	GND	28	GND	29	PE89	30	PE90
31	PE20	32	GND	33	PE21	31	PE91	32	PE92	33	GND
34	GND	35	PE22	36	PE23	34	PE93	35	GND	36	PE94
37	PE24	38	PE25	39	GND	37	GND	38	PE95	39	PE96
40	PE26	41	GND	42	PE27	40	PE97	41	PE98	42	GND
43	GND	44	PE28	45	PE29	43	PE99	44	GND	45	PE100
46	PE30	47	PE31	48	GND	46	PE101	47	PE102	48	PE103
49	PE32	50	GND	51	PE33	49	PE104	50	PE105	51	GND
52	GND	53	PE34	54	PE35	52	PE106	53	GND	54	PE107
55	PE36	56	PE37	57	GND	55	GND	56	PE108	57	PE109
58	PE38	59	GND	60	PE39	58	PE110	59	PE111	60	PE112
61	GND	62	PE40	63	PE41	61	PE113	62	GND	63	PE114
64	PE42	65	PE43	66	GND	64	PE115	65	PE116	66	PE117
67	PE44	68	GND	69	PE45	67	PE118	68	PE119	69	GND
70	GND	71	PE46	72	PE47	70	PE120	71	GND	72	PE121
73	PE48	74	PE49	75	GND	73	GND	74	PE122	75	PE123
76	PE50	77	GND	78	PE51	76	PE124	77	PE125	78	PE126
79	GND	80	PE52	81	PE53	79	PE127	80	GND	81	PE128
82	PE54	83	PE55	84	GND	82	SPI_CLK	83	SPI_CS	84	SPI_DIN
85	PE56	86	GND	87	PE57	85	SPI_DOUT	86	FLASH_WP	87	GND
88	GND	89	PE58	90	PE59	88	FLASH_POWER	89	GND	90	PROBE_ID6
91	PE60	92	PE61	93	GND	91	GND	92	PROBE_ID7	93	PROBEID_CS0
94	PE62	95	GND	96	PE63	94	PROBEID_CS1	95	RELAY_EN0	96	RELAY_EN1
97	GND	98	PE64	99	PE65	97	EXP_PRESENT	98	GND	99	PROBE_PRESENT
100	PE66	101	PE67	102	GND	100	GND	101	GND	102	GND

103	GND	104	GND	105	PE68	103	VCC	104	VCC	105	VCC

The signals are described in the following table:

Table 3-7 Interface Signals of Main Board and Transducer Board

SIGNAL NAME	DESCRIPTION
SPI_CLK	When a transducer is connected, it serves as read and write signal as transducer ID. When the transducer extension module is connected, it serves as command and data signal.
SPI_DIN	
SPI_DOUT	
SPI_CS	
FLASH_POWER	When a transducer is connected, it serves as FLASH power.
FLASH_WP	When a transducer is connected, it serves as FLASH write protection (low level write protection)
PROBE_ID[7:6]	reserved signal
PROBEID_CS[1:0]	
RELAY_EN[1:0]	
PROBE_PRESENT	When a transducer is connected, it serves as indication signal (low level indicates a transducer connected)
EXP_PRESENT	When the transducer extension module is connected, it serves as indication signal (low level indicates the extension module connected)
PE[1:128]	128-channel transmission and reception signal

1.1.1.1.16. Interfaces of Main Board and Transmission Board

The interface signals of the main board and transmission board are defined in the following tables.

Table 3-8 Input Interfaces of Transmission Board

CON1							
PIN	SIG	PIN	SIG	PIN	SIG	PIN	SIG
1	TPU58	2	TPU73	61	TPU82	62	TPU90
3	GND	4	GND	63	GND	64	GND
5	TPU50	6	TPU75	65	TPU127	66	TPU128
7	GND	8	GND	67	GND	68	GND
9	TPU79	10	TPU77	69	TPU89	70	TPU92
11	GND	12	GND	71	GND	72	GND
13	TPU71	14	TPU83	73	TPU91	74	TPU123
15	GND	16	GND	75	GND	76	GND
17	TPU49	18	TPU85	77	TPU121	78	TPU122

19	GND	20	GND	79	GND	80	GND
21	TPU57	22	TPU87	81	TPU124	82	TPU126
23	GND	24	GND	83	GND	84	GND
25	TPU41	26	TPU76	85	TPU119	86	TPU118
27	GND	28	GND	87	GND	88	GND
29	TPU56	30	TPU74	89	TPU116	90	TPU120
31	GND	32	GND	91	GND	92	GND
33	TPU72	34	TPU78	93	TPU112	94	TPU113
35	GND	36	GND	95	GND	96	GND
37	TPU54	38	TPU88	97	TPU105	98	TPU103
39	GND	40	GND	99	GND	100	GND
CON1							
41	TPU68	42	TPU86	101	TPU114	102	TPU110
43	GND	44	GND	103	GND	104	GND
45	TPU80	46	TPU84	105	TPU104	106	TPU107
47	GND	48	GND	107	GND	108	GND
49	TPU66	50	TPU81	109	TPU108	110	TPU106
51	GND	52	GND	111	GND	112	GND
53	TPU93	54	TPU96	113	TPU101	114	TPU97
55	GND	56	GND	115	TPU100	116	TPU99
57	TPU95	58	TPU94	117	GND	118	GND
59	GND	60	GND	119	TPU98	120	TPU102
CON2							
PIN	SIG	PIN	SIG	PIN	SIG	PIN	SIG
1	TPU5	2	TPU34	61	TPU16	62	TPU61
3	GND	4	GND	63	GND	64	GND
5	TPU2	6	TPU42	65	TPU40	66	TPU45
7	TPU3	8	TPU46	67	TPU18	68	TPU37
9	GND	10	GND	69	GND	70	GND
11	TPU1	12	TPU25	71	TPU20	72	TPU29
13	TPU4	14	TPU48	73	TPU22	74	TPU70
15	GND	16	GND	75	GND	76	GND
17	TPU8	18	TPU23	77	TPU24	78	TPU69
19	TPU10	20	TPU62	79	TPU26	80	TPU52
21	GND	22	GND	81	GND	82	GND
23	TPU12	24	TPU21	83	TPU59	84	TPU60
25	TPU14	26	TPU64	85	TPU44	86	TPU51

27	GND	28	GND	87	GND	88	GND
29	TPU11	30	TPU19	89	TPU43	90	TPU125
31	TPU9	32	TPU27	91	TPU36	92	TPU115
33	GND	34	GND	93	GND	94	GND
35	TPU7	36	TPU33	95	TPU35	96	TPU109
37	TPU17	38	TPU65	97	TPU117	98	TPU111
39	GND	40	GND	99	GND	100	GND
41	TPU15	42	TPU55	101	VDD	102	VDD
43	TPU13	44	TPU63	103	GND	104	GND
45	GND	46	GND	105	GND	106	GND
47	TPU6	48	TPU47	107	GND	108	GND
49	TPU28	50	TPU39	109	12V	110	12V
51	GND	52	GND	111	GND	112	GND
53	TPU30	54	TPU31	113	GND	114	GND
55	TPU32	56	TPU67	115		116	
57	GND	58	GND	117	PHV	118	PHV
59	TPU38	60	TPU53	119	PHV	120	PHV

Table 3-9 Output Interfaces of Transmission Board

CON1							
PIN	SIG	PIN	SIG	PIN	SIG	PIN	SIG
1	POUT1	2	POUT2	61	POUT33	62	POUT34
3	GND	4	GND	63	GND	64	GND
5	POUT3	6	POUT4	65	POUT35	66	POUT36
7	POUT5	8	POUT6	67	GND	68	GND
9	GND	10	GND	69	POUT37	70	POUT38
11	POUT7	12	POUT8	71	GND	72	GND
13	POUT9	14	POUT10	73	POUT39	74	POUT40
15	GND	16	GND	75	GND	76	GND
17	POUT11	18	POUT12	77	POUT41	78	POUT42
19	GND	20	GND	79	GND	80	GND
21	POUT13	22	POUT14	81	POUT43	82	POUT44
23	GND	24	GND	83	GND	84	GND
25	POUT15	26	POUT16	85	POUT45	86	POUT46
27	GND	28	GND	87	GND	88	GND
29	POUT17	30	POUT18	89	POUT47	90	POUT48
31	GND	32	GND	91	GND	92	GND

33	POUT19	34	POUT20	93	POUT49	94	POUT50
35	GND	36	GND	95	GND	96	GND
37	POUT21	38	POUT22	97	POUT51	98	POUT52
39	GND	40	GND	99	GND	100	GND
41	POUT23	42	POUT24	101	POUT53	102	POUT54
43	GND	44	GND	103	GND	104	GND
45	POUT25	46	POUT26	105	POUT55	106	POUT56
47	GND	48	GND	107	GND	108	GND
49	POUT27	50	POUT28	109	POUT57	110	POUT58
51	GND	52	GND	111	GND	112	GND
53	POUT29	54	POUT30	113	POUT59	114	POUT60
55	GND	56	GND	115	POUT61	116	POUT62
57	POUT31	58	POUT32	117	GND	118	GND
59	GND	60	GND	119	POUT63	120	POUT64
CON2							
PIN	SIG	PIN	SIG	PIN	SIG	PIN	SIG
1	POUT65	2	POUT66	61	POUT97	62	POUT98
3	GND	4	GND	63	GND	64	GND
5	POUT67	6	POUT68	65	POUT99	66	POUT100
7	POUT69	8	POUT70	67	GND	68	GND
9	GND	10	GND	69	POUT101	70	POUT102
11	POUT71	12	POUT72	71	GND	72	GND
13	POUT73	14	POUT74	73	POUT103	74	POUT104
15	GND	16	GND	75	GND	76	GND
17	POUT75	18	POUT76	77	POUT105	78	POUT106
19	GND	20	GND	79	GND	80	GND
21	POUT77	22	POUT78	81	POUT107	82	POUT108
23	GND	24	GND	83	GND	84	GND
CON2							
25	POUT79	26	POUT80	85	POUT109	86	POUT110
27	GND	28	GND	87	GND	88	GND
29	POUT81	30	POUT82	89	POUT111	90	POUT112
31	GND	32	GND	91	GND	92	GND
33	POUT83	34	POUT84	93	POUT113	94	POUT114
35	GND	36	GND	95	GND	96	GND
37	POUT85	38	POUT86	97	POUT115	98	POUT116
39	GND	40	GND	99	GND	100	GND

41	POUT87	42	POUT88	101	POUT117	102	POUT118
43	GND	44	GND	103	GND	104	GND
45	POUT89	46	POUT90	105	POUT119	106	POUT120
47	GND	48	GND	107	GND	108	GND
49	POUT91	50	POUT92	109	POUT121	110	POUT122
51	GND	52	GND	111	GND	112	GND
53	POUT93	54	POUT94	113	POUT123	114	POUT124
55	GND	56	GND	115	POUT125	116	POUT126
57	POUT95	58	POUT96	117	GND	118	GND
59	GND	60	GND	119	POUT127	120	POUT128

1.1.1.1.17. Interfaces of Main board and CW Board

The interface signals of the main board and CW board are defined in the following tables.

Table 3-10 CW CON1 Interface Pins

PIN	SIGNAL	PIN	SIGNAL
1	GND	2	GND
3	CW0	4	CW1
5	GND	6	GND
7	CW2	8	CW3
9	GND	10	GND
11	CW4	12	CW5
13	GND	14	GND
15	CW6	16	CW7
17	GND	18	GND
19	CW8	20	CW9
21	GND	22	GND
23	GND	24	GND
25	12V	26	12V
27	GND	28	GND
29	-12V	30	-12V
31	GND	32	GND
33	5V	34	5V
35	GND	36	GND
37	-5V	38	-5V
39	GND	40	GND

The interface signals of CW CON1 are defined in the following table:

Table 3-11 Interface Signals of CW CON1

Signal name	Signal Description
CW[9:0]	CW echo signal
12V	+12 power
-12V	-12V power
5V	+5V power
-5V	-5V power

Table 3-12 CW CON2 Interface Pins

PIN NUM	Signal name	Signal description
1	AD_NRST	AD reset signal (you may not use it)
2	RESERVED	reserved, not used yet
3	RESERVED	reserved, not used yet
4	RESERVED	reserved, not used yet
5	GND	
6	GND	
7	LOCLK_P	quadrature demodulation local oscillation input (if it is difference, it is positive end)
8	RESERVED	reserved, not used yet
9	LOCLK_N	quadrature demodulation local oscillation input (if it is difference, it is negative end)
10	RESERVED	reserved, not used yet
11	GND	
12	GND	
13	RESERVED	reserved, not used yet
14	RESERVED	reserved, not used yet
15	RESERVED	reserved, not used yet
16	AD_HPFD	AD internal high-pass filter enable control (it is always-on, it may not be used.)
17	GND	
18	GND	
19	AD_LRCK	left & right sound channel output clock of AD audio serial port (Audio serial port left/right (or word) clock)
20	AD_DATA	AD audio serial port output data (Audio serial port left and right channel PCM data)
21	AD_BCK	AD audio serial port output bit clock (Audio serial port bit clock)
22	SW_CTRL	analog switch channel selection control signal
23	GND	
24	GND	

25	TPU	pencil probe drive signal input
26	RESERVED	reserved, not used yet
27	GND	
28	GND	
29	RESERVED	reserved, not used yet
30	RESERVED	reserved, not used yet
31	RESERVED	reserved, not used yet
32	GND	
33	GND	
34	GND	
35	D3V3	
36	D3V3	
37	GND	
38	GND	
39	HV	programmable high voltage
40	HV	programmable high voltage

1.1.1.1.18. Interfaces of Clock Chip JTAG

The interfaces of clock chip JTAG are defined in the following table:

Table 3-13 Sockets of Main Board Clock Chip JTAG

PIN	SIG
1	CLK_TMS
2	CLK_TDI
3	CLK_TDO
4	CLK_TCK
5	GND
6	VDD_CLK

1.1.1.1.19. Interfaces of Main Board and 4D Board

The interfaces of the main board and 4D board are designed to be reserved, and the reserved interfaces are defined in the Table 3-14 Interface Signals of Main Board and 4D Board.

Table 3-14 Interface Signals of Main Board and 4D Board

Pin	Signal	Pin	Signal
1	+12V	2	+12V
3	+12V	4	+12V
5	+12V	6	+12V
7	GND	8	GND

9	GND	10	USB-2
11	USB_2_3_OC_N	12	USB+2
13	Gnd	14	Gnd
15	+5V	16	+5V
17	+5V	18	+5V
19	GND	20	GND
21	GND	22	GND
23	+3.3V	24	+3.3V
25	GND	26	GND
27	STEP	28	DIR
29	SLEEP	30	Reserved
31	Reserved	32	Reserved
33	GND	34	GND
35	SPI_CLK (reserved SPI Adinterface)/Txd	36	SPI_DIN/Rxd
37	SPI_DOUT	38	SPI_/CS
39	GND	40	GND

1.1.1.1.20. Interfaces of Main Board and Modulation Module

The interfaces of the main board and modulation module are defined in Table 3-15 Interfaces of Main Board and Modulation Module.

Table 3-15 Interfaces of Main Board and Modulation Module

PIN NUM	NET NAME	PIN NUM	NET NAME
1	GND	2	GND
3	12V	4	12V
5	12V	6	12V
7	12V	8	12V
9	12V	10	12V
11	GND	12	GND
13	GND	14	GND
15	GND	16	GND
17	GND	18	GND
19	5V	20	5V
21	5V	22	5V
23	3.3V	24	3.3V
25	3.3V	26	3.3V
27	3.3V	28	3.3V
29	3.3V	30	3.3V

31	GND	32	GND
33	GND	34	VGA_SDA
35	GND	36	GND
37	GND	38	VGA_SCL
39	GND	40	GND
41	GND	42	VGA_VSYNC
43	GND	44	GND
45	GND	46	VGA_HSYNC
47	GND	48	GND
49	GND	50	VGA_BLUE
51	GND	52	GND
53	GND	54	VGA_GREEN
55	GND	56	GND
57	GND	58	VGA_RED
59	GND	60	GND

1.1.1.1.21. Interfaces of Main Board and Speakers

The interfaces of the main board and speakers are defined in the following table:

Table 3-16 Interfaces of Main Board and Speakers

PIN	SIG
1	ROUTP
2	ROUTN
3	NC
4	LOUTP
5	LOUTN

1.1.1.1.22. Interfaces of Main Board and Fan

The interfaces of the main board and fan are defined in the following table:

Table 3-17 Interfaces of Main Board and Fan

PIN	SIG	PIN	SIG
1	FANSPEED4	2	12V
3	PWM45	4	12V
5	FANSPEED5	6	CPU_FAN_PN
7	FANSPEED2	8	CPU_FAN_SPEED
9	PWM23	10	12V
11	FANSPEED3	12	12V

1.1.1.1.23. Socket Interfaces of Main Board CPLD JTAG

The sockets of the main board CPLD JTAG are defined in the following table:

Table 3-18 Sockets of Main Board CPLD JTAG

PIN	SIG
1	TCK
2	TDO
3	TMS
4	TDI
5	3V3
6	GND
7	3V3
8	PLUGED

1.1.1.1.24. Reserved Signal Interfaces

The reserved signal interfaces are defined in the following table:

Table 3-19 reserved signal interfaces

No.	Name	No.	Name
1	I^C_DA	2	GND
3	I^C_CK	4	GND
5	GND	6	Gnd
7	Power_ON	8	HD_Status
9	SYS_RESET	10	Gnd
11	C_Print	12	Breaker_Status
13	C_Busy	14	Gnd
15	Gnd	16	Y_Svideo
17	Power_SSW	18	C_Svideo
19	Gnd	20	Gnd

1.1.1.1.25. Reserved Power Interfaces

The reserved power interfaces are defined in the following table:

Table 3-20 Reserved Power Interfaces

No.	Name	No.	Name
1	+12V	2	+12V
3	+12V	4	+12V
5	Gnd	6	Gnd
7	Gnd	8	Gnd

9	Gnd	10	Gnd
11	+5V	12	+5V
13	+5V	14	+5V
15	+5V	16	+5V
17	+5V	18	+5V
19	Gnd	20	Gnd
21	Gnd	22	Gnd
23	+3.3V	24	+3.3V

1.1.1.1.26. Interfaces of Main Board and Battery Connection Board

The interfaces of the main board and battery connection board are defined in the following table:

Table 3-21 interfaces of the main board and battery connection board

No.	Name	Direction	Description	Remark
1	SDA_A	\		
2	SDA_A	\		
3	SDA_B	IN/OUT	SM Bus	
4	SCL_B	OUT	SM Bus	
5	A_Battery_Status	IN	Battery A capacity indication	
6	B_Battery_Status	IN	Battery B capacity indication	
7	A_Battery_NTC	IN	Battery A temperature detection	
8	B_Battery_NTC	IN	Battery B temperature detection	
9	Gnd	\		
10	Gnd	\		
11-16	A_Battery+	IN/OUT		
17-22	A_Battery-	OUT/IN		
23-28	B_Battery+	IN/OUT		
29-32	B_Battery-	OUT/IN		
33	nBattery_Present_A	In	low level indicates battery existence	
34	nBattery_Present_B	In	low level indicates battery existence	

1.1.1.1.27. Interfaces of Main Board and Adapter

The interfaces of the main board and adapter are defined in the following table:

Table 3-22 interfaces of the main board and adapter

No.	Name	Direction
1	Gnd	\
6	Gnd	\
2	Gnd	\

4	Gnd	\
3	+12V	In
7	+12V	In
5	+12V	In
8	+12V	In

1.1.1.1.28. Interfaces of Main Board and Power Board

The interfaces of the main board and power board are defined in Table 3-24 interface signals of main board and power board interfaces of the main board and power board. The signal description is shown in Table 3-24 interface signals of main board and power board. The signal direction is relative to the power board.

Table 3-23 interfaces of the main board and power board

Pin No.	Name	Pin No.	Name
1	EDC_Power	2	EDC_Power
3	EDC_Power	4	EDC_Power
5	GND	6	GND
7	GND	8	GND
9	A_Battery+	10	A_Battery+
11	A_Battery-	12	A_Battery-
13	B_Battery+	14	B_Battery+
15	B_Battery-	16	B_Battery-
17	Gnd	18	Gnd
19	A_Battery_NTC	20	B_Battery_NTC
21	EDC_Status	22	Power_ON
23	Gnd	24	Scan_Status
25	Temperature_D+	26	CW_Mode
27	Temperature_D-	28	+5VStb_CPU_En
29	Gnd	30	Gnd
31	+5VStb	32	+5VStb_CPU
33	+12V	34	+12V
35	Gnd	36	Gnd
37	GND	38	GND
39	-12V	40	-5V
41	Gnd	42	Gnd
43	+5V	44	+5V
45	Gnd	46	Gnd
47	+2.5V	48	+2.5V
49	Gnd	50	Gnd

51	Gnd	52	NC
53	+1.5V	54	+1.5V
55	Gnd	56	Gnd
57	3.3V	58	3.3V
59	Gnd	60	Gnd
61	Gnd	62	Gnd
63	THV	64	THV_Range

Table 3-24 interface signals of main board and power board

No.	Name	Direction	Description	Remark
1	+12V	In	EDC in (external adapter input)	10A
2	+11.1V	In	Battery in (internal battery input)	9200mA
3	EDC_Status	Out	Indicating if the system is connected to the network power; high level indicates the system is connected to network power, and is normally powered. When the system is powered by battery, it is in the low level status.	5V TTL level
4	Scan_Status	In	The system allows the batteries to be charged in the scanning status. Low level indicates the system is in the scanning status and the batteries are not allowed to be charged.	5V TTL level
5	CW_mode	In	Controlling the output range of programmable high voltage. When it is low level, THV output voltage is adjustable in the range of 20~140V; when it is high level, THV output voltage is in the range of 5~10V.	5V TTL level
6	Power_ON	IN	Power output control. When it is low level, power board outputs should work normally.	5V TTL level
	+5Vstb_CPU_EN	IN	+5Vstb_CPU output control. When it is low level, +5Vstb_CPU should normally output.	5V TTL level
7	THV_Range	IN	programmable high voltage output control	
8	Temperature_D+	Out	ambient temperature detection of power board	
9	Temperature_D-	out	ambient temperature detection of power board	
10	A_Battery_NTC	IN	Battery temperature detection	
11	B_Battery_NTC	IN	Battery temperature detection	
12	+12V	Out		
13	THV	Out	programmable high voltage	
14	+5V	Out		
15	+5VStb	Out		
16	+5VStb_CPU	Out		
17	+3.3V	Out		
18	+2.5A	Out		
19	+1.5V	Out		
20	-5V	Out		

21	-12V	Out	Used for the CW board	
22	NC	/	No connection	

1.1.1.1.29. Interfaces of Main Board and Extension Module

The interfaces of the main board and extension module are defined in Table 3-25 Interface Signals of Main Board and Extension Module.

Table 3-25 Interface Signals of Main Board and Extension Module

pin	signal	pin	signal	pin	signal	pin	signal
A1	USB+4	B1	USB-4	C1	USB+5	D1	USB-5
A2	VBUS_SYS45	B2	GND	C2	VBUS_SYS45	D2	GND
A3	GND	B3	VGA_HS	C3	VGA_RED	D3	VGA_GREEN
A4	UART_RX0	B4	VGA_VS	C4	GND	D4	GND
A5	UART_TX0	B5	GND	C5	VGA_BLUE	D5	D0
A6	GND	B6	AUDIO_L	C6	GND	D6	D1
A7	RM_PRINT	B7	AUDIO_R	C7	D2	D7	GND
A8	RM_BUSY	B8	GND	C8	D3	D8	AUTOFD_N
A9	GND	B9	D7	C9	D4	D9	BUSY
A10	MIC_L	B10	PE	C10	GND	D10	GND
A11	MIC_R	B11	STROBE_N	C11	D5	D11	ACK_N
A12	VIDEO	B12	INIT_N	C12	D6	D12	SELIN_N
\	\	B13	SEL	\	\	D13	ERROR_N

1.1.1.1.30. Interfaces of Main Board and Keyboard

The interfaces of the main board and keyboard are defined in Table 3-26 interfaces of the main board and keyboard.

Table 3-26 interfaces of the main board and keyboard

No.	Name	No.	Name
1	+3.3V	2	+3.3V
3	+3.3V	4	+3.3V
5	Gnd	6	Gnd
7	Gnd	8	Gnd
9	+5V	10	+5V
11	+5V	12	+5V
13	Gnd	14	Gnd
15	Gnd	16	Gnd
17	Gnd	18	Gnd
19	Work_Status_O	20	Work_Status_G
21	Battery_Status_O	22	Battery_Status_G

23	Gnd	24	EDC_Status_G
25	USB_DN	26	LCD_SW
27	USB_DP	28	Power_BTN
29	Gnd	30	Gnd

3.2.2.9 Testing Points of Main Board

The testing points of the main board are shown in the following figures:

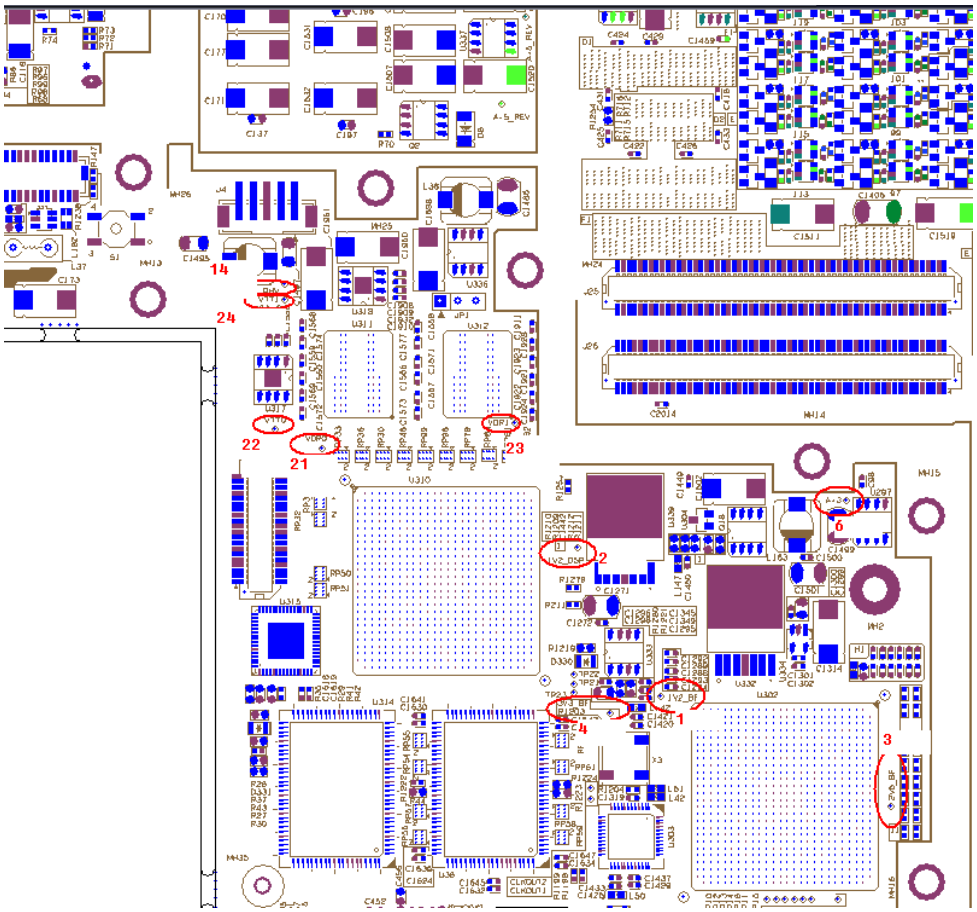


Figure 3-6 Testing Points of Main Board (1)

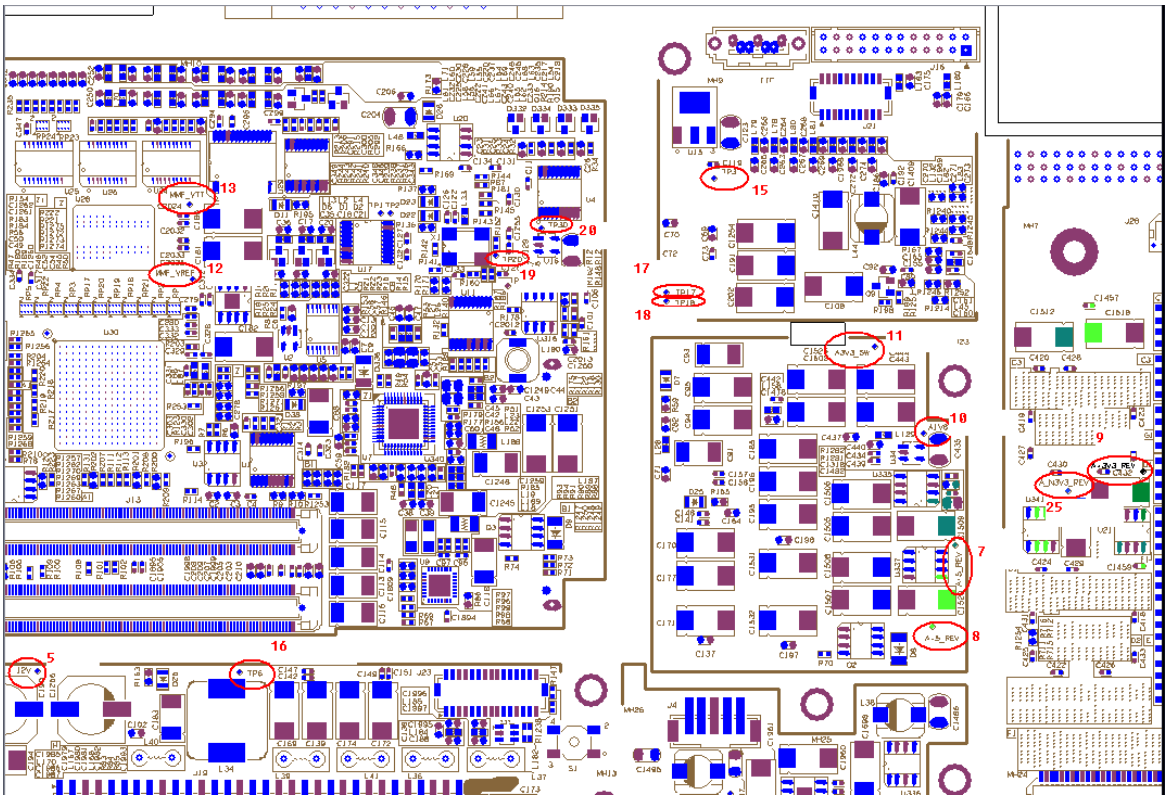


Figure 3-7 Testing Points of Main Board (2)

Table 3-27 Testing Points of Main Board

No.	Testing points	Testing point network
1	1V2_BF	FPGA1 core voltage (1.2V)
2	1V2_DSP	FPGA2, FPGA3 core voltage (1.2V)
3	2V5_BF	FPGA1 IO voltage (2.5V)
4	3V3_BF	FPGA1 IO voltage (3.3V)
5	12V	12V voltage
6	A+3	Variable gain amplifier voltage (3V)
7	A+5V_REV	reception module voltage (4.65V)
8	A-5V_REV	reception module voltage (-4.65V)
9	A+3V3_REV	reception module voltage (3.3V)
10	A1V8	reception module voltage (1.8V)
11	A3V3_SW	reception module voltage (3.3V)
12	MMF_VREF	FPGA3 DDR voltage (1.25V)
13	MMF_VTT	FPGA3 DDR voltage (1.25V)
14	PHV	programmable high voltage510V(CW),20-140V(B\C\D)
15	TP3	STB voltage (3.3V)
16	TP6	working voltage (5V)
17	TP17	audio amplifier left channel input

18	TP18	audio amplifier right channel input
19	TP20	Power management CPLD clock (6M)
20	TP30	Power management CPLD power (1.8V)
21	VDR0	FPGA2 DDR0 voltage (1.25V)
22	VTT0	FPGA2 DDR0 voltage (1.25V)
23	VDR1	FPGA2 DDR1 voltage (1.25V)
24	VTT1	FPGA2 DDR1 voltage (1.25V)
25	A_N3V3_REV	Voltage of reception module(-3.3V)

3.2.3 Principle of Transmission Board

The function of the transmission board is to transform low-voltage pulse from the main board to hight-voltage pulse for transmission. The schematic diagram is shown below:

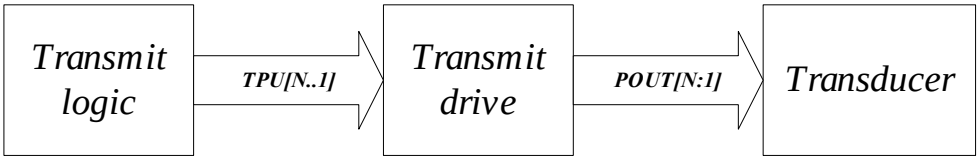


Figure 3-8 Schematic Diagram of Transmission Board

The interfaces of the transmission board and main board are described in Table 3-8 Input Interfaces of Transmission Board and Table 3-9 Output Interfaces of Transmission Board. The testing points of the transmission board are described in the following table:

Table 3-28 testing points of the transmission board

No.	Testing points	Testing point network
1	PHV	programmable high voltage5—10V(CW),20-140V(B\C\D)
2	A+12	11.4V voltage
3	VOE	3.3V voltage

The transmission signals in the transmission board all have testing points, as shown in the figure below:

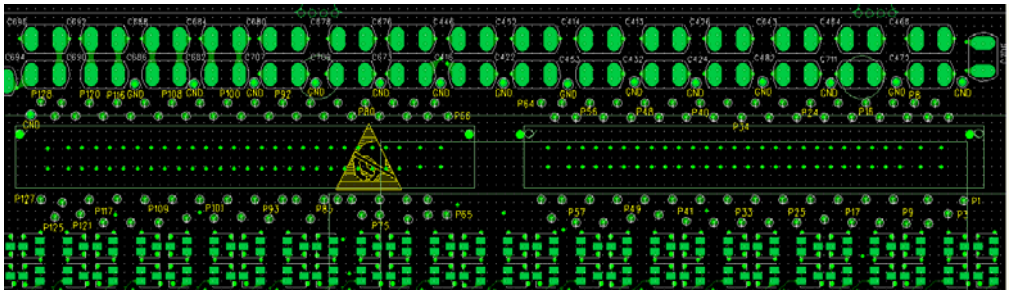


Figure 3-9 testing points of transmission board transmitting pulse

The testing points correspond to the transmission channels. There are four rows of testing points, the upper two rows represent even channels and the lower two rows represent odd channels. The channel number is marked, for example, P65 represents the 65th transmission channel.

The testing waveform of transmission signal in B mode is shown in the figure below:

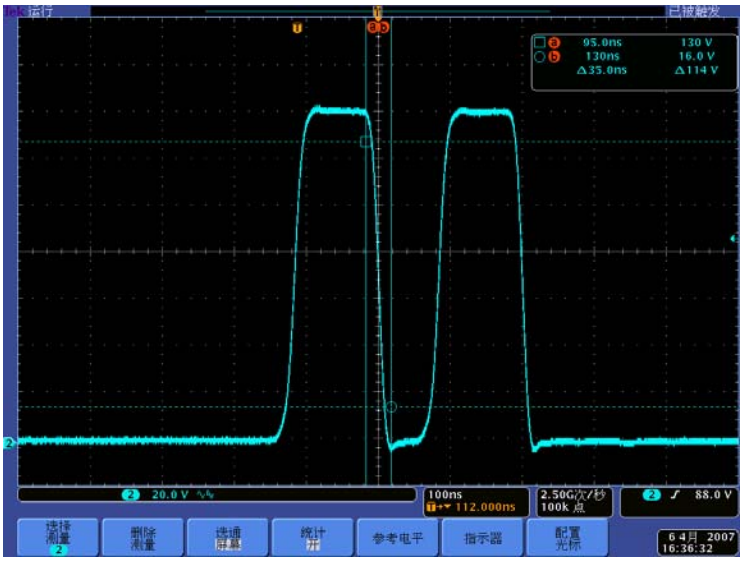


Figure 3-10 testing waveform of transmission signal in B mode

The figure above is a schematic figure, since the amplitude, width and number of the transmission pulse vary depending upon transmission parameters.

3.2.4 Principle of CW Board

The principle of the CW board is shown in Figure 3-11. The board contains a continuous wave reception channel and a transmission and reception channel of the pencil probe. It consists of the following modules: interface unit (including power filter and conversion);delay line unit; pencil probe unit; low-pass filter unit; demodulation unit; wall filter unit; gain adjusting unit and A/D conversion unit. In the board, the power is divided into analog power and digital power. The analog power consists of A+5V, VCC (5V), A-5V, A+12V, A-12V, PHV, A+1v5; digital power consists of VDD(3.3V).

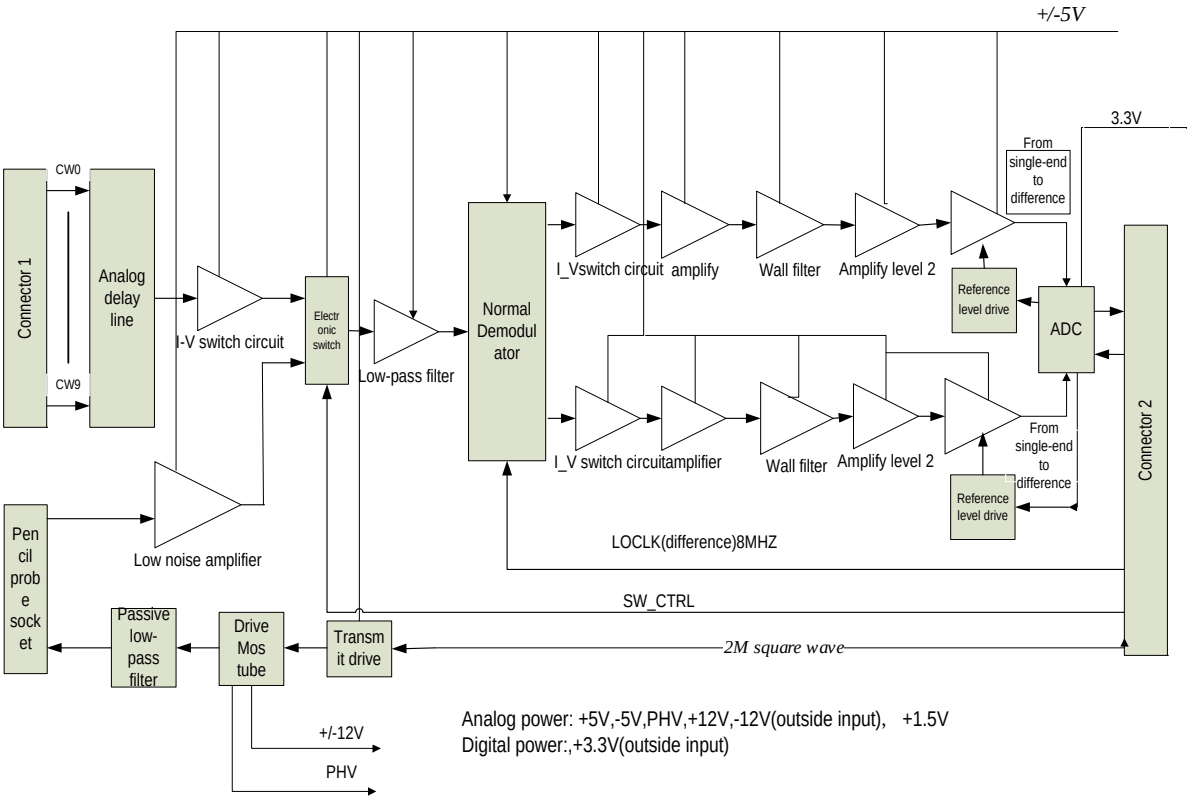


Figure 3-11 Schematic Diagram of CW Board

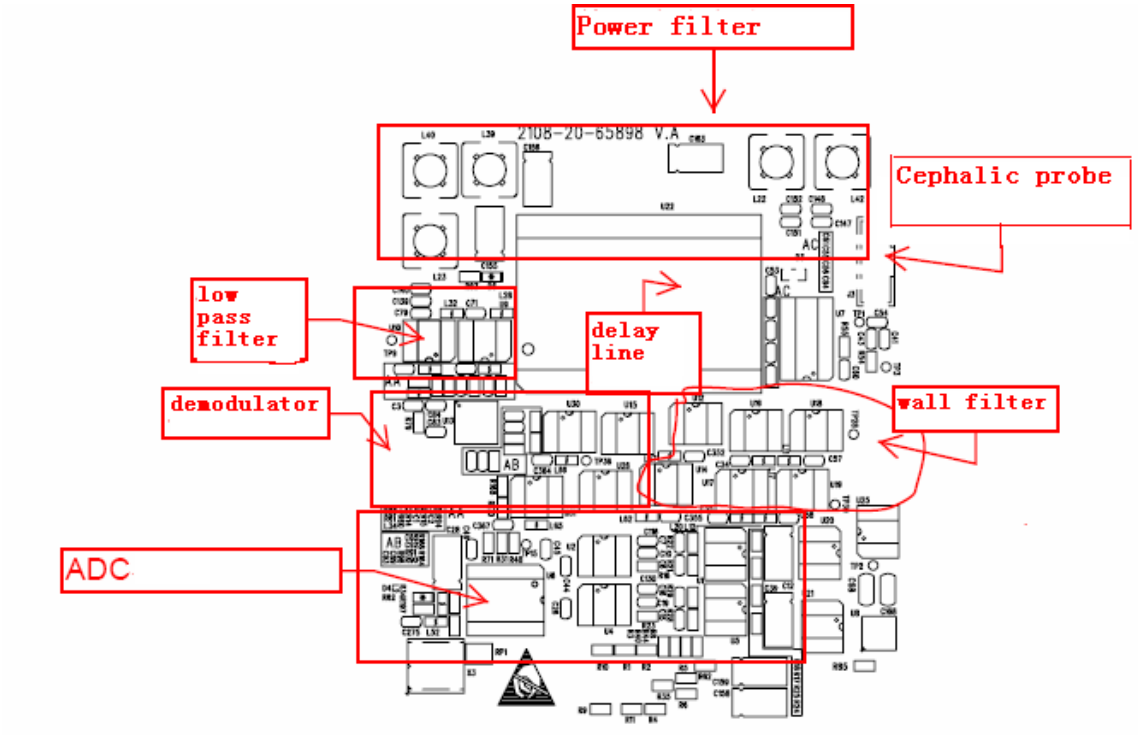


Figure 3-12 Component distribution on front face of CW board

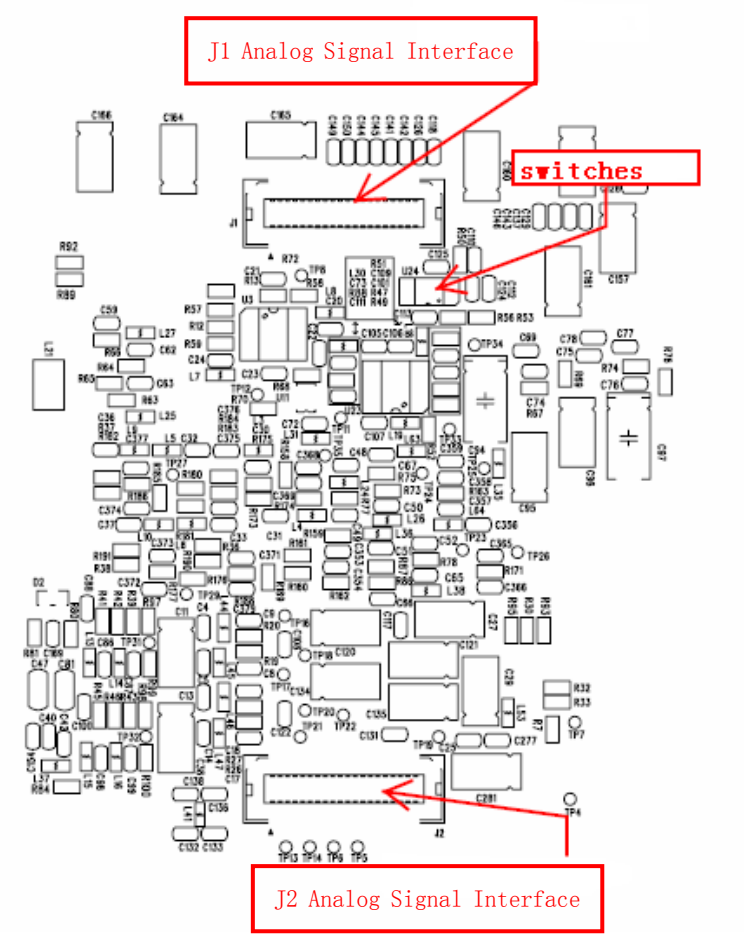


Figure 3-13 Component distribution on back face of CW board

3.2.4.1 Description of Interface Circuit

The interface unit consists of analog signal interface socket (connect 1), digital signal interface socket (connect 2), power filter circuit and 1.5V power conversion circuit. The detailed socket pins are defined in interfaces of analog and digital signals.

The filter portion is used to provide filter processing for power from the main board and to provide power indicators for +5V and 3.3V power signals and serial 510Ω current-limiting resistor for power indicator loop, as shown in the figure below.

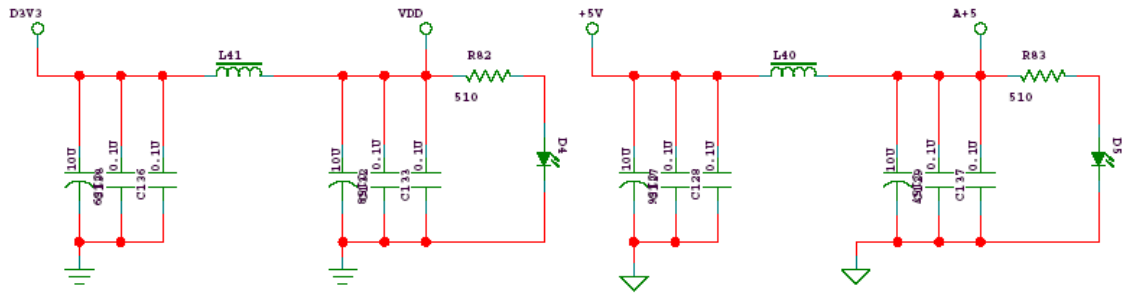


Figure 3-14 power indicators

The 1.5V conversion circuit is used to convert +5V to 1.5V through a low-voltage difference converter, and the voltage control is determined by peripheral sampling resistor in terms of R1=R2*[(VOUT/0.9)-1].

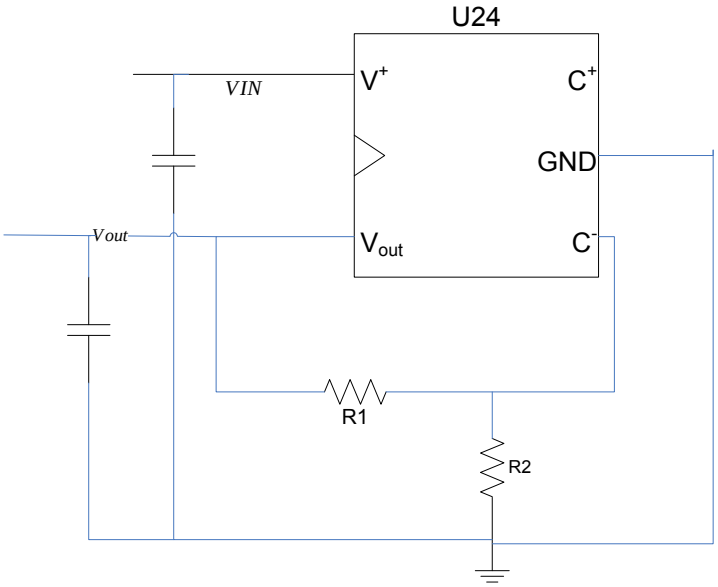


Figure 3-15 1.5V conversion circuit

3.2.4.2 Description of Delay Line Circuit

The delay line unit is used to integrate CW signals into one-way current signal through the delay line; however, to accommodate the subsequent quadrature demodulation, filter, amplifier and A/D converter, it needs to convert current signal to voltage signal output. Therefore this unit consists of two parts, delay line circuit and I-V conversion circuit.

3.2.4.3 Description of Pencil Probe Unit

The pencil probe unit consists of transmission and reception circuits.

The transmission circuit is shown in the figure below:

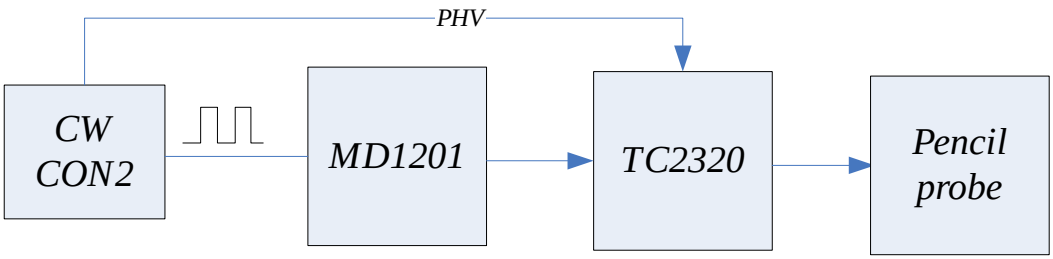


Figure 3-16 Diagram of pencil probe transmission

The reception circuit is used to amplify signal received by pencil probe, then to send the signal to the front-end filter unit and to pass through analog switch with voltage waveform from CW output and to reach filter demodulation and A/D sampling circuit.

3.2.4.4 Low-pass Filter

The low-pass filter implements two functions, one is to perform channel switch selection for CW voltage waveform and pencil probe reception signal through analog switch; the other is to perform filter processing for analog switch output signal. The main control board is used to give control signal to control channel selection. The S1 and S2 channels are respectively connected to CW voltage signal and pencil probe reception signal. The control signal SW_CTRL is generated by FPGA and connected to pull-down resistor at analog switch pin, to ensure that input channel is CW input by

default. The two active filter units are applied to the filter circuit to implement four-level low-pass filter. The schematic diagram of analog switch is as follows:

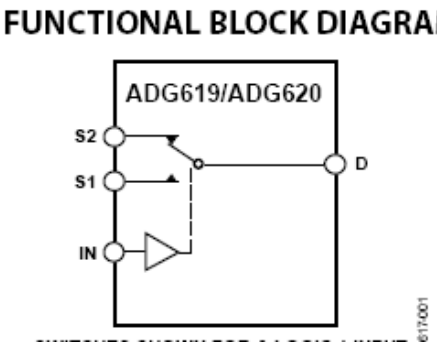


Figure 3-17 Diagram of analog switch

The block diagram of a low-pass filter IS as follows:

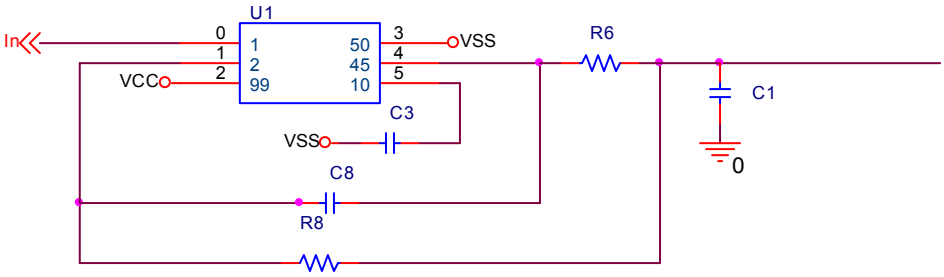


Figure 3-18 Block diagram of low-pass filter

3.2.4.5 Demodulation Circuit

The quadrature demodulation unit is used to convert analog signal from pre-filter, through quadrature demodulation, to I/Q baseband signal for subsequent sampling unit.

3.2.4.6 Wall Filter Circuit

After quadrature demodulation, the two I and Q voltage signals will be processed through high-pass and low-pass filters. In the CW Doppler system reception circuit, the high-pass filter is used to eliminate DC level caused by crosstalk and low frequency signal caused by slowly-moving tissues, thus making best of dynamic range of ADC. The structure of high-pass filter is shown in the figure below. The low-pass filter in the CW reception circuit is used to filter high-frequency harmonics with large amplitude caused by mixing and to filter broad band noise.

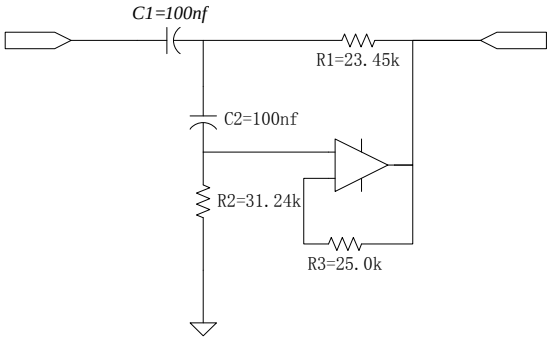


Figure 3-19 structure of high-pass filter (2-level Bessel)

3.2.4.7 Gain Adjusting Circuit

The gain adjusting circuit consists of two parts, one is before high-pass and low-pass filter, the other is after high-pass and low-pass filter. The gain is controlled through a feedback resistor, and changing the resistance of the feedback resistor can change the close-loop gain. The purpose of gain magnified is to adjust the I and Q signal amplitudes to full range of A/D converter.

3.2.4.8 AD Conversion Circuit

The I and Q signals, whose gains are adjusted through AD8671, are sampled by the high-resolution A/D converter. ADC requires that the analog input is difference unipolar signal and amplifying stage output is single-end signal, so a single end shall be added into the difference circuit, and the ADC input needs a 2.5V DC bias voltage. Therefore this unit is added with a reference-level drive circuit.

3.2.4.9 Socket Definition

The interfaces of boards and system consist of analog signal interface, digital signal interface and pencil probe interface.

1.1.1.1.31. Analog Signal Interface

The analog signal interface J1 contains continuous wave current signal input and power input in the analog circuit.

Table 3-29 analog signal interfaces

PIN NUM	SIGNAL	PIN NUM	SIGNAL	PIN NUM	SIGNAL	PIN NUM	SIGNAL
1	AGND	2	AGND	21	AGND	22	AGND
3	CW0	4	CW1	23	AGND	24	AGND
5	AGND	6	AGND	25	+12V	26	+12V
7	CW2	8	CW3	27	AGND	28	AGND
9	AGND	10	AGND	29	-12V	30	-12V
11	CW4	12	CW5	31	AGND	32	AGND
13	AGND	14	AGND	33	+5V	34	+5V
15	CW6	16	CW7	35	AGND	36	AGND
17	AGND	18	AGND	37	-5V	38	-5V
19	CW8	20	CW9	39	AGND	40	AGND

Table 3-30 analog signal interface

Signal name	Signal description
CW[9:0]	CW echo signal
12V	
5V	
-5V	

1.1.1.1.32. Digital Signal Interfaces

The digital signal interface J2 contains digital signals of boards and main control board and digital power input signal.

Table 3-31 digital signal interfaces

PIN No.	SIGNAL	PIN No.	SIGNAL	PIN No.	SIGNAL	PIN No.	SIGNAL
1	PHSPI_CLK	2	PHSPI_CS	21	AD_BCK	22	CW_SWITCH
3	PHSPI_DIN	4	CW_DR_DIN	23	GND	24	GND
5	GND	6	GND	25	CW_PPEIN	26	CW_PPPRESENT
7	LO_P	8	CW_DR_DS	27	GND	28	GND
9	LO_N	10	CW_DR_CLK	29	USB-3	30	USB+3
11	GND	12	GND	31	USB_VBUS3	32	GND
13	DEM_CLK	14	DEM_DIN	33	GND	34	GND
15	DEM_CS	16	DEM_DOUT	35	D3V3	36	D3V3
17	GND	18	GND	37	GND	38	GND
19	AD_LRCK	20	AD_DATA	39	HV	40	HV

Table 3-32 digital signal interfaces

PIN No.	Interface signal name	Board signal name	Signal description
1	PHSPI_CLK	SAMPLE_CLK	AD sampling clock
2	PHSPI_ CS	AD_NRST	AD reset signal
3	PHSPI_ DIN	AD_CLIPR	AD right channel output mark
4	CW_DR_DIN	FS0	AD sampling mode selection
5	GND		
6	GND		
7	LO_P	LOCLK_P	quadrature demodulation local oscillation input (if it is difference, it is positive end)
8	CW_DR_CS	FS1	AD sampling mode selection
9	LO_N	LOCLK_Q	quadrature demodulation local oscillation input (if it is difference, it is negative end)
10	CW_DR_CLK	FS2	AD sampling mode selection
11	GND		
12	GND		
13	DEM_CLK	NC	reserved, not used yet
14	DEM_DIN	NC	reserved, not used yet
15	DEM_CS	NC	reserved, not used yet
16	DEM_DOUT	AD_HPFD	AD internal high-pass filter enable control
17	GND		
18	GND		

19	AD_LRCK	AD_LRCK	AD audio serial port left and right channel output clock
20	AD_DATA	AD_DATA	AD audio serial port output data
21	AD_BCK	AD_BCK	AD audio serial port output clock
22	CW_SWITCH	SW_CTRL	analog switch channel selection control signal
23	GND		
24	GND		
25	CW_PPEIN	TPU	pencil probe drive signal input
26	CW_PPPRESENT	AD_CLIPL	AD left channel output mark
27	GND		
28	GND		
29	USB-3	NC	reserved, not used yet
30	USB+3	NC	reserved, not used yet
31	USB_VBUS3	NC	reserved, not used yet
32	GND		
33	GND		
34	GND		
35	D3V3		
36	D3V3		
37	GND		
38	GND		
39	HV	HV	programmable high voltage
40	HV	HV	programmable high voltage

1.1.1.1.33. Pencil Probe Interface

The pencil probe interface J3 defines reception and transmission interfaces of the pencil probe.

Table 3-33 4D pencil probe interfaces

PIN NUM	SIGNAL
1	PIN
2	PENPRESENT
3	AGND
4	POUT

Table 3-34 pencil probe interfaces

Signal name	Signal description

PIN	pencil probe reception
POUT	pencil probe transmission
PENPRESENT	pencil probe connected signal

3.2.5 Principle of Keyboard Board

The functions of the control panel (keyboard board) are shown in Figure 3-20 functional block diagram of control panel. FPGA is control panel's core, and inside there is CPU soft core NiosII. The peripheral devices of the control panel consists of encoder, key, trackball, LED, buzzer and TGC. The control panel needs to be provided with 3.3V and 5V power, and there are 1.2V and 2.5V LDO inside. The 5V is applied to the encoder, trackball, LED and drive circuit; however 3.3V is applied to all other circuits.

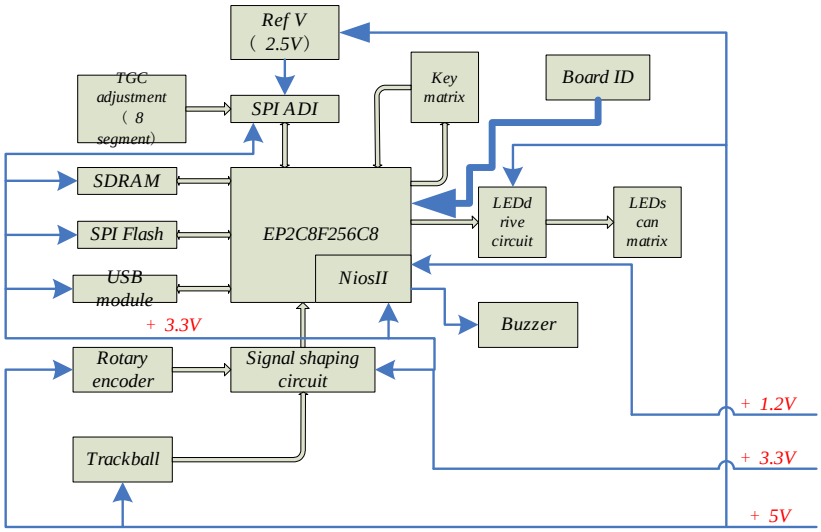


Figure 3-20 functional block diagram of control panel

3.2.5.1 LED Drive Circuit

LED matrix has 4 rows, and row and line control method is adopted. The diagram is shown in Figure 3-21 Diagram of key control.

The "row signal" is connected to positive pole of LED, and driven by EL7212. When the control signal (EL7212 input pin) is high level, LED's positive pole is connected to 5V power and in the "row enable" status.

The "line signal" is connected to the negative pole of LED. When FPGA control 74LS07 output is low level, the LED is in the "line enable" status.

When LED control signals for row and line are both in the enable status, this LED illuminates.

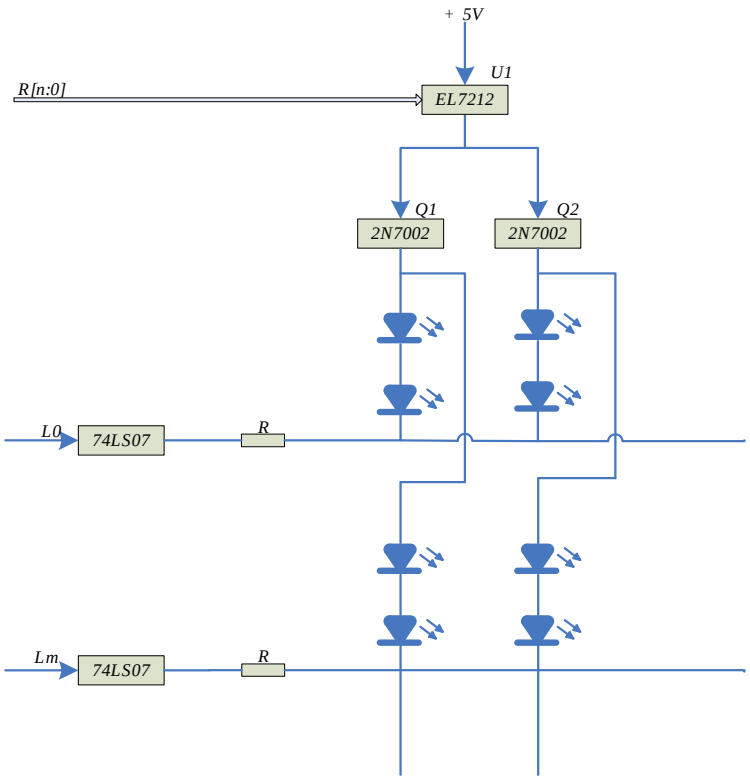


Figure 3-21 Diagram of key control

3.2.5.2 Key Scanning Circuit

The key matrix has 11 lines and 12 rows, and row and line control method is adopted. FPGA line-by-line output tests signals. When a key is pressed, the corresponding row and line signals shall be consistent. According to the numbers of the row and line, the position of the key pressed can be known.

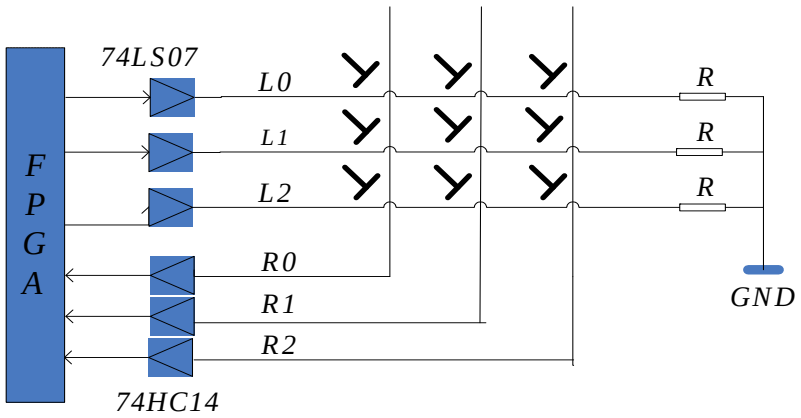


Figure 3-22 Principle of key scanning

3.2.5.3 Trackball Input Signal Processing

The data returned from the trackball interface is square waveform data. There are a pair of signal cables in X and Y directions, and four signal cables. The trackball is powered by 5V, supplied by the control panel.

3.2.5.4 Buzzer

The buzzer drive circuit is shown in Figure 3-23 buzzer drive circuit. The buzzer has two control signals, controlled by FPGA through 74LS07. When the amplitude of the signals is large (typical 3.8V) the volume of the buzzer is large; when amplitude of the signals is small (typical 1.9V) the volume of the buzzer is small. The signal frequency determines the buzzer audio frequency (typical value 3khz).

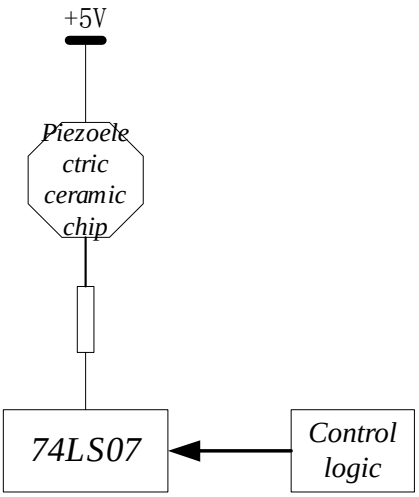


Figure 3-23 buzzer drive circuit

3.2.5.5 Encoder Circuit

On the control panel there are two encoders, and each encoder has two signal cables, and output signal is in the form of square waveform and 5V level.

3.2.5.6 TGC Interface Circuit

TGC is a group of sliding rheostats, and relation between its output voltage and slider displacement is linear. The output analog voltage, through AD converter, is converted to digital signal and sent to FPGA, thus obtaining the slider position. AD is powered by 3.3V, externally connected to 2.5V reference level. To keep precision of the AD converter, the output of the sliding potentiometer is applied with LM358 for follow-up. The interface is shown in Figure 3-24 TGC Interface Circuit.

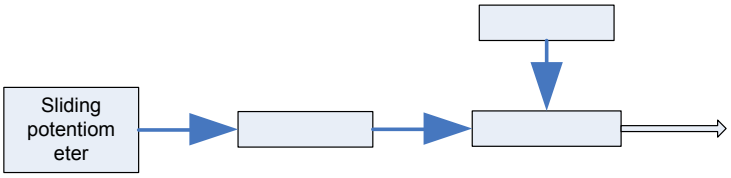


Figure 3-24 TGC Interface Circuit

3.2.5.7 FPGA and Peripheral Circuit

FPGA is the core of boards and cards, externally connected to SPI flash and SDRAM. Its logic and software codes are stored in SPI Flash, and they are loaded to FPGA and the software initiates when powered on.

NiosIIsoft core is a 32bit CPU. It can read and write SPI Flash on line and support on-line code upgrading.

FPGA, Flash and SDRAM are all 3.3V devices. The core voltage of FPGA is 1.2V. The frequency of the crystal oscillator connected with FPGA is 25MHz (testing point: U19 pin4).

3.2.5.8 USB Communication Interface

FPGA is externally connected with a USB interface chip U4 (3.3V device), supporting USB communication protocol 1.1. The frequency of the external crystal oscillator X1 is 6Mhz. USB interface is shown in Figure 3-25 USB Interface. In the figure L8 is common mode suppression inductor, and U5 is anti-static chip.

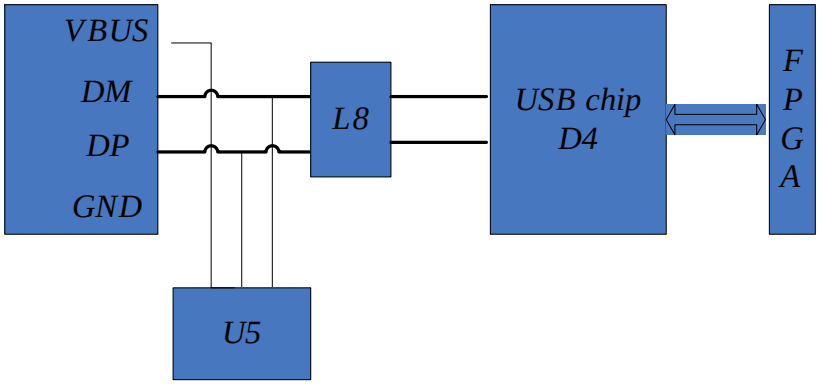


Figure 3-25 USB Interface

3.2.5.9 Socket Definition

The components and sockets positions of the control panel are shown in Figure 3-26 and Figure 3-27. The socket definition is shown in Table 3-35 keyboard board socket definition.

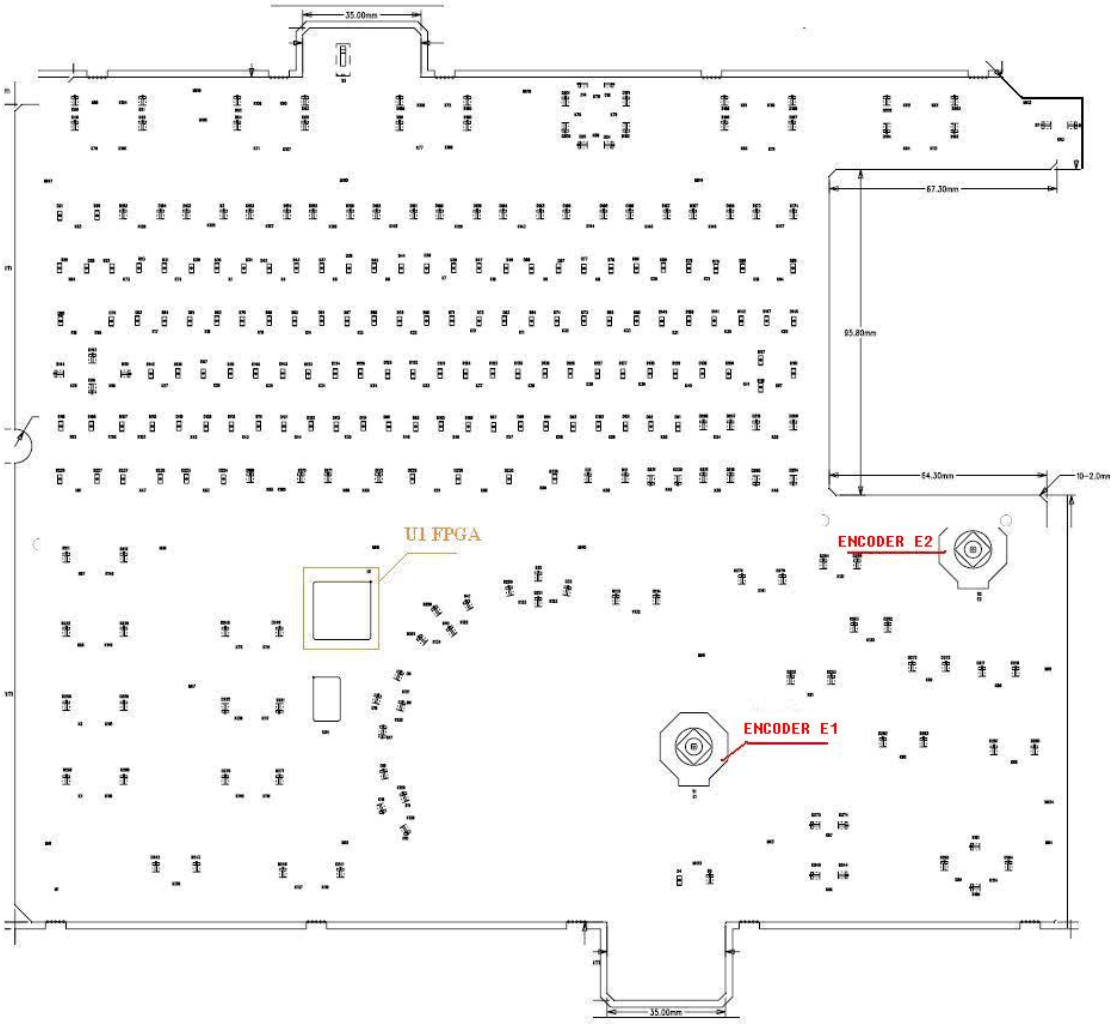


Figure 3-26 control panel top component distribution

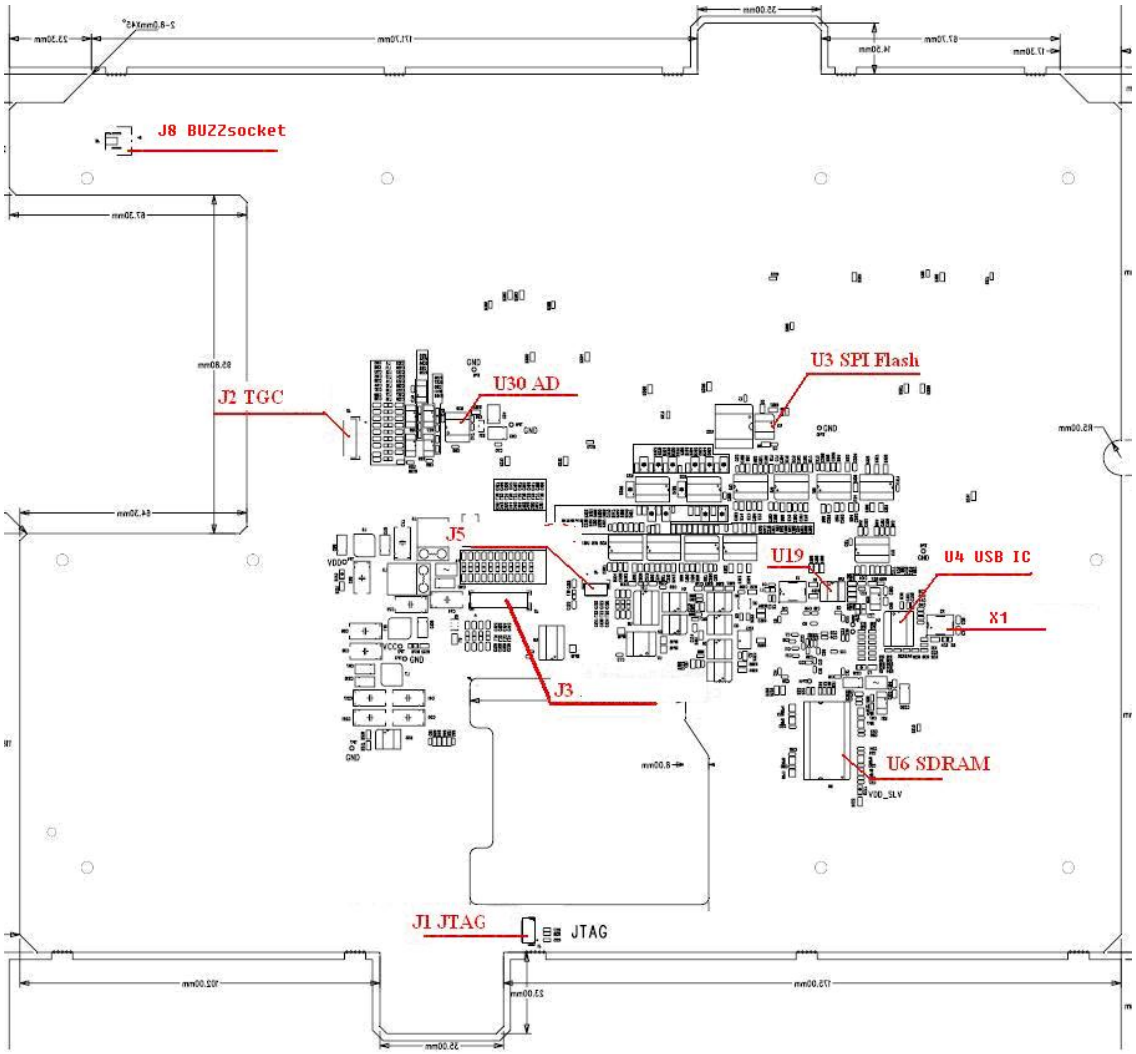


Figure 3-27 control panel bottom component distribution

Table 3-35 keyboard board socket definition

Socket PCB position	Name	Pin definition			Remark
		Pin No	Pin definition	Pin description	
J1	JTAG debugging socket	1	TCK	TCK signal , pull-down	
		2	TDO	TDO signal	
		3	TMS	TMS signal , pull-up 3.3V	
		4	TDI	TDI signal , pull-up 3.3V	
		5	VDD	3.3V power	
		6	GND	system ground	
J2	TGC socket	1	TGC VDD	3.3V power	
		2	GND	system ground	
		3	ATGC0	Slider 0 output signal	
		4	ATGC1	Slider 1 output signal	

		5	ATGC2	Slider 2 output signal	
		6	ATGC3	Slider 3 output signal	
		7	ATGC4	Slider 4 output signal	
		8	ATGC5	Slider 5 output signal	
		9	ATGC6	Slider 6 output signal	
		10	ATGC7	Slider 7 output signal	
J3	main board connection socket	3	DP	USB-DP signal	
		4	POWER_STB	Power status	power switch K93 connected
		5	DN	USB-DN signal	
		6	LCD_SW	display position status	display position switch S3 connected
		8	EDC_STATUS_G	EDC status	indicator D4 connected
		9	BATTERY_STATUS_O	battery status O	Indicator D5 connected
		10	BATTERY_STATUS_G	battery status G	indicator D5 connected
		11	WORK_STATUS_O	work status O	indicator D6-7 connected
		12	WORK_STATUS_G	work status G	indicator D6-7 connected
		1,2,7,13~18,23~26	GND	system ground	
		19~22	+5	external input 5V	
		27~30	+3V3	external input 3.3V	
J5	Trackball socket	1	GND	system ground	
		2	VCC	5V	
		3	TRACK_HBALL2	trackball signal 2	signal 0 and signal 1 are a pair; signal 2 and signal 3 are a pair.
		4	TRACK_HBALL3	trackball signal 3	
		5	TRACK_HBALL0	trackball signal 0	
		6	TRACK_HBALL1	trackball signal 1	
J8	Buzzer socket	1	BUZ0	buzzer signal 0	
		2	BUZ1	buzzer signal 1	

3.2.6 Principle of ECG Board

The function of the ECG board contains: ECG signal detection; ECG waveform display; ultrasound image reference signal; real-time 2-D image and color flow image synchronous signal.

After the ECG signal is amplified, filtered and sampled, it is sent to PC, and passes through R-waveform detection. After ECG trigger signal is detected, through USB PORT, it is sent to PC. The system diagram is shown in the figure below:

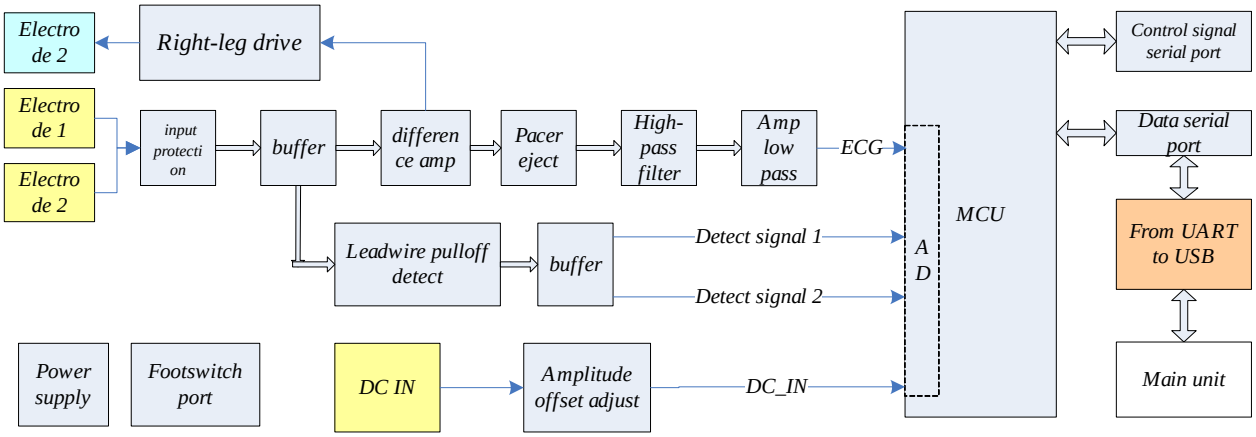


Figure 3-28 functional block diagram of ECG board

3.2.6.1 Principle of ECG Board Power

ECG board is powered by USB, and the voltage is 5V. After going through the step-up circuit, the 5V is transformed to 12V. The T1 is isolated transformer. The 12V power is isolated and sent to ECG board analog and digital circuit for power. The power functional block diagram is shown in the figure below:

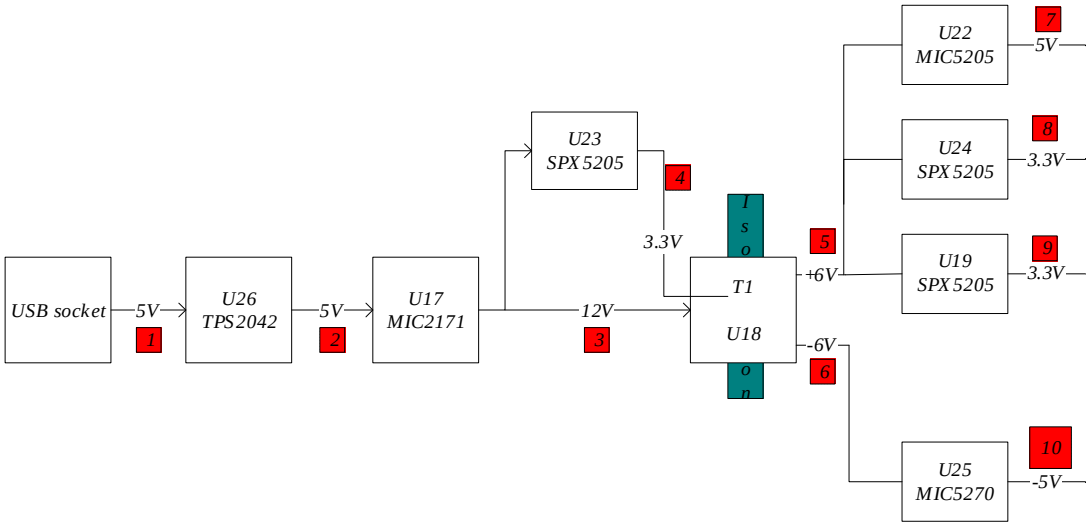


Figure 3-29 functional block diagram of ECG board power

3.2.6.2 Plug-in Mounting Figure and Component Description

The plug-in mounting of ECG board is shown in Figure 3-30. The figure marks the sockets and their names.

The blue dotted line indicates the component isolation boundary. The right area indicates the power circuit and communication port, and the left area indicates ECG signal processing circuit.

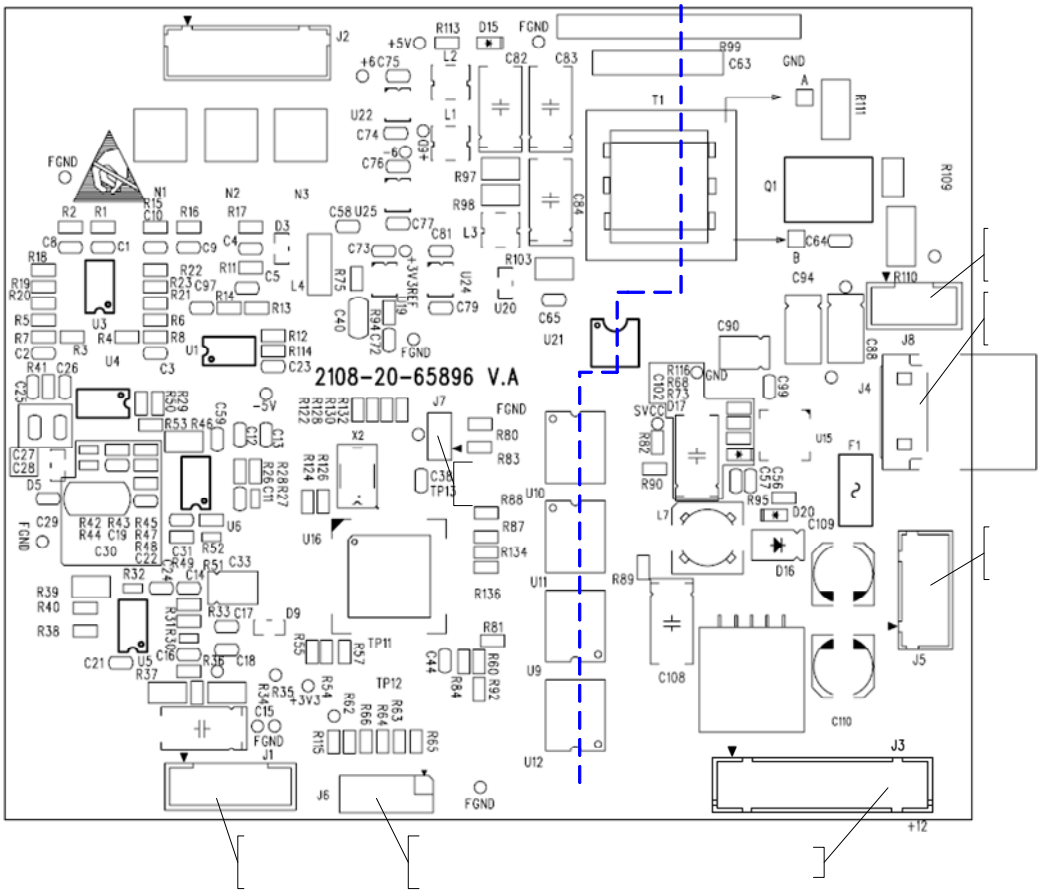


Figure 3-30 plug-in mounting of ECG board

The interfaces of boards and cards are shown in the figure, and interface definition is shown in the table below.

Table 3-36 ECG board socket description

Socket PCB position	Name	Pin definition			Remark
		Pin No	Pin definition	Pin description	
J1	DC_IN socket	1	FGND	ECG module floating ground	
		2	FGND	ECG module floating ground	
		3	DC_IN	DC IN input	
		4	DC_IN	DC IN input	
		5	FGND	ECG module floating ground	
		6	FGND	ECG module floating ground	

J2	leadwire cable interface socket	1	Lead_F_IN	leadwire cable Green	
		2	Lead_R_IN	leadwire cable Red	
		3	Lead_N_DR	leadwire cable Black (connecting to right leg)	
		4	NC	Not connected	
		5	C_SHIELD	cable shield drive	
		6	NC	Not connected	
J3	Main system interface socket	1	GND	ground of the main system	
		2	+12V	main system power	
		3	GND	ground of the main system	
		4	+12V	main system power	
		5	ECG_CTRLT	serial control transmit	
		6	+12V	main system power	
		7	ECG_CTRLR	serial control reception	
		8	GND	ground of the main system	
		9	GND	ground of the main system	
		10	GND	ground of the main system	
		11	ECG_DATAT	serial data transmit	
		12	GND	ground of the main system	
		13	ECG_DATAR	serial data reception	
		14	GND	ground of the main system	
		15	GND	ground of the main system	
		16	GND	ground of the main system	
		17	ROW	Input of footswitch common end	
		18	GND	ground of the main system	
		19	LINE1	footswitch line1 input	
		20	LINE2	footswitch line2 input	
J4	USB socket	1	VBUS	5V input	
		2	DM	difference signal DM	
		3	DP	difference signal DP	
		4,5,6	GND	ground of the main system	
J5	Footswitch socket	1	ROW	Input of footswitch common end	
		2	LINE1	footswitch line1 input	
		3	LINE2	footswitch line2 input	
		4	NC	Not connected	
J6	JTAG debugging socket	1	VCC	3.3V	debugging
		2	GND	ECG module floating ground	
		3	TRST	JTAG——TRST signal	

		4	TCK	JTAG——TCK signal	
		5	TDI	JTAG——TDI signal	
		6	TDO	JTAG——TDO signal	
		7	TMS	JTAG——TMS signal	
		8	RTCK	JTAG——RTCK signal	
		9	NRST	JTAG——NRST signal	
		10	NC	Not connected	
J7	ARM BOOT socket	1	/	ARMchipLPC213X P0.14 pin connected	Service
		2	GND	ECG module floating ground	
J8	USB socket	1	VBUS	5V VBUS signal	
		2	USB-		
		3	USB+	JTAG——TRST signal	
		4	TCK	JTAG——TCK signal	

3.2.7 Principle of Video/Audio Capture Card

The diagram of video capture card is shown in the figure below:

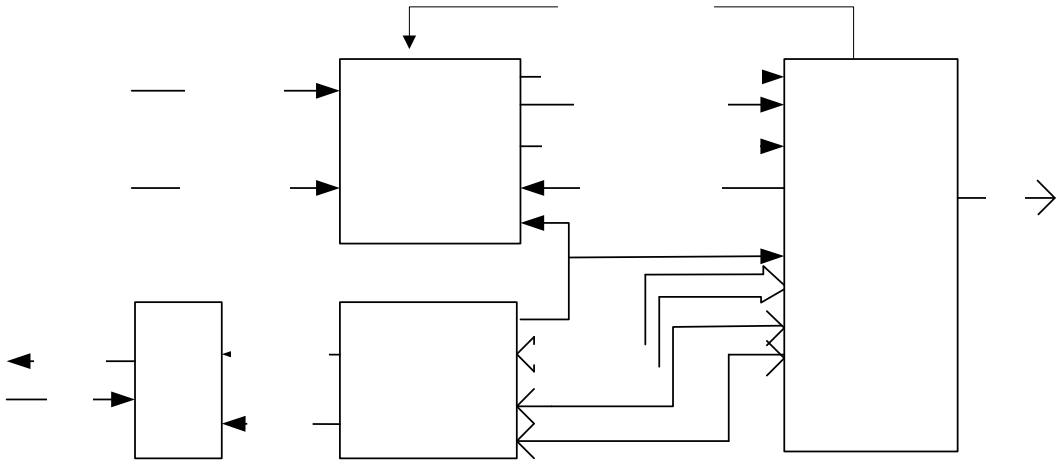


Figure 3-31 diagram of video/audio capture card

The power relation of video audio capture card is shown in the figure below:

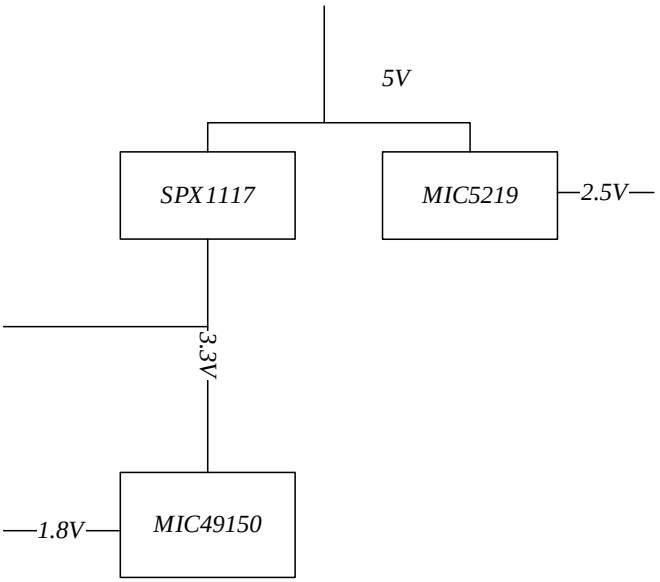


Figure 3-32 power relation of video/audio capture card

Principle of the video capture card is described as follows:

After the video capture card is powered on, EM2860 first resets and registers the chip, and then TVP5150 resets. At this moment the system displays the newly found hardware, that is, EM2860. After EM2860 resets, GPIO1 signal will change, through PMOS SEMICONDUCTOR control, EMP202 resets.

After the process is complete, the BCLK and VCLK both have clock signals, and SYNC has cyclic pulse.

When the capture software is started, EM2860 LED pin is pulled high, and the board green LED illuminates. The video capture card transmits the video capture configuration in the software to TVP5150 through I2C bus. The TVP5150, according to command transmit channel, selects command to send to analog switch ADG774, and select encoding method corresponding to configuration.

TVP5150 converts the input video signal to 8-bit digital signal, and transmits it to EM2860. EMP202 transmits the captured audio signal to EM2860 through serial channel. EM2860 integrates the received signal and sends it to PC main unit through USB interface.

3.2.8 Principle of Transducer Extension Module

The structure of the transducer extension module is shown in the figure below:

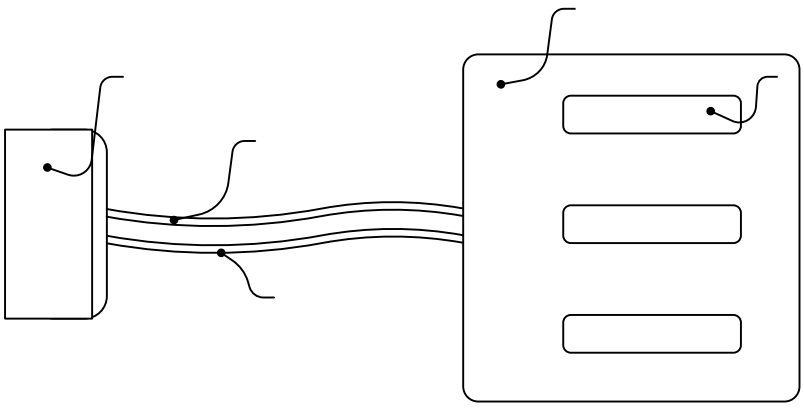


Figure 3-33 Structure of transducer extension module

The transducer extension module consists of front-end extension module connector, control cable and transducer signal cable, and main body of extension module. The main body of the extension module is the main part of the module, implementing variety of module's control functions.

In the main body of the extension module, two PCB boards are connected via the board-to-board socket, forming the main part of the module. Its principle is shown in the figure below.

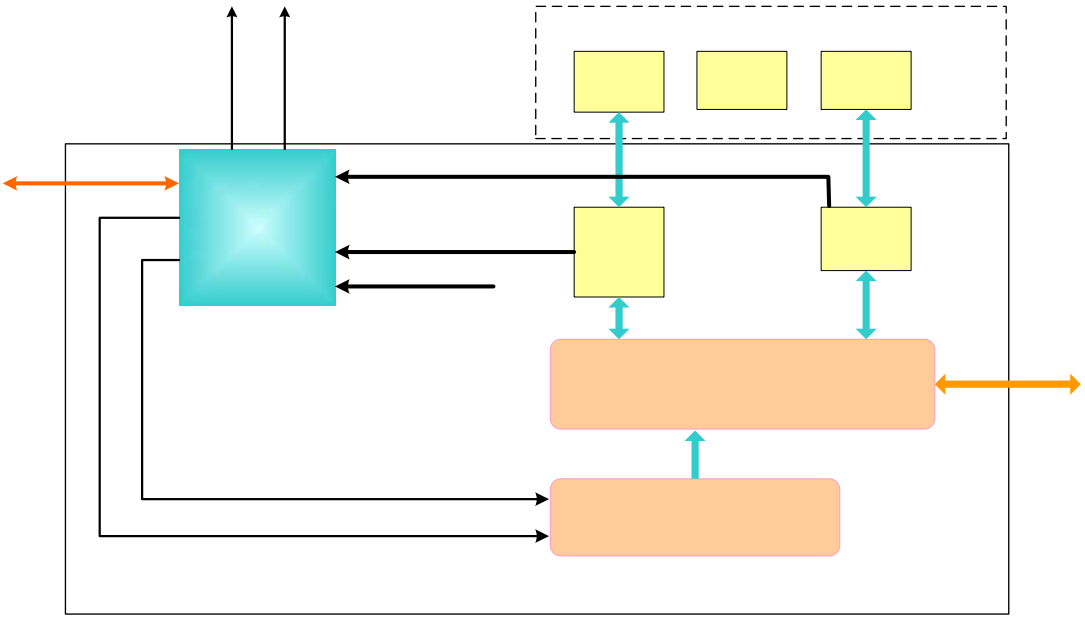


Figure 3-34 Functional Diagram of Extension Module

The main unit communicates with the extension module via SPI bus, and a CPLD analyzes the SPI command, and executes variety of the main unit's commands, such as transducer selection, transducer identification, and read of boards and cards codes. The transducer signal switch is implemented via a relay. There are three sockets in the transducer extension module, two are effective, and one is docking socket for placing a transducer.

3.2.8.1 Description of Power Structure

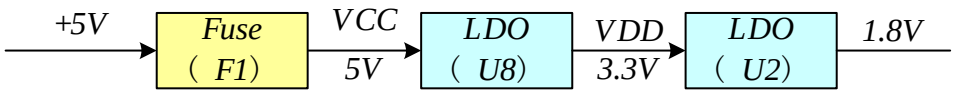


Figure 3-35 Power Diagram of Transducer Extension Module

In the B transducer extension board (2108 -30-65887), there are 5V, 3.3V, and 1.8V powers. The 3.3V and 1.8V are obtained through LDO. The 3.3V is working voltage for digital devices, and the 1.8V is CPLD's core voltage.

3.2.8.2 Device Distribution of B Transducer Extension Board

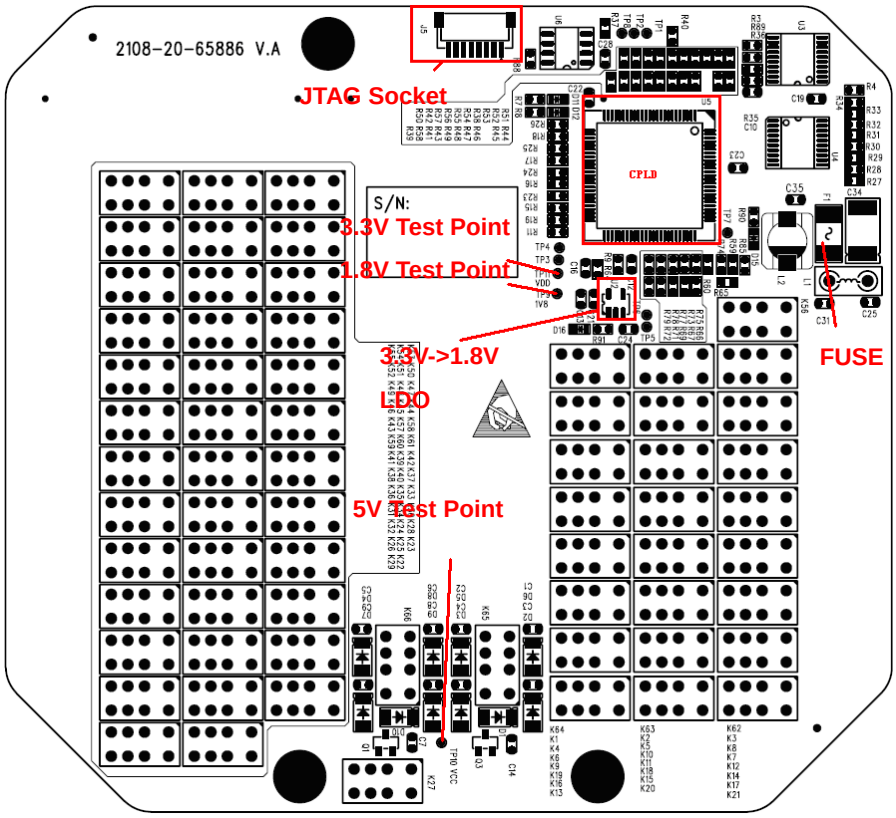


Figure 3-36 TOP Face Screen Printing of B Transducer Extension Board

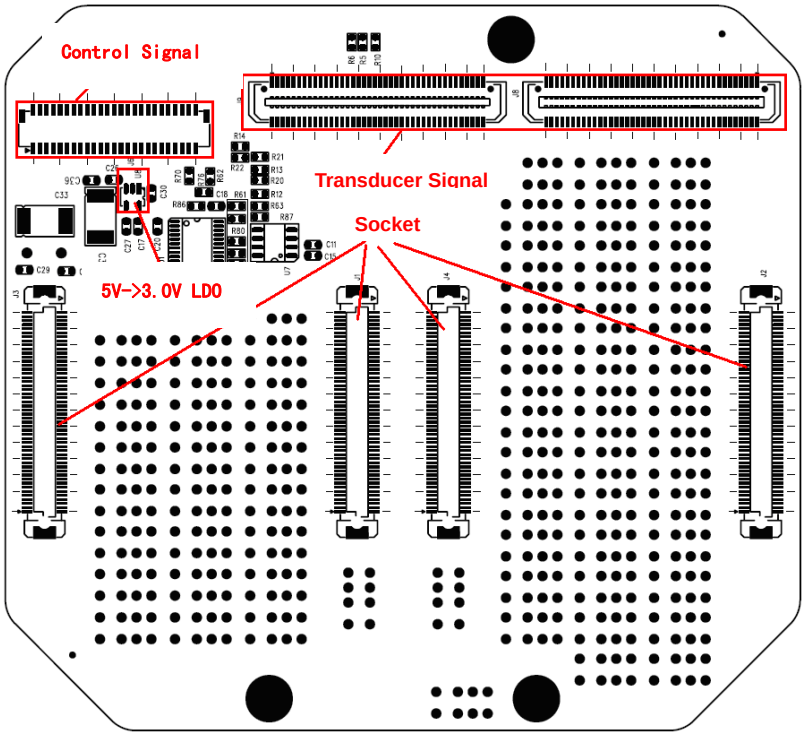


Figure 3-37 BOT Face Screen Printing of B Transducer Extension Board

3.3 Software Startup

First Phase: BIOS guide process; startup graphics 1 and blue progress bar at the bottom of the screen are displayed.

Second Phase: WINDOWS guide process; startup graphics 2 is switched to startup graphics, and the blue progress bar is displayed at the bottom of the screen.

Third Phase: ultrasound software guide process; startup graphics 3 and the blue progress bar (round angle) at the bottom of the screen are displayed. The progress bar indicates the following steps:

Step 1: displays no progress bar; initializes the system clock and soft interrupt module;

Step 2: displays the progress bar, but without progress, initializes setup server, requires setup data;

Step 3: displays 1/7 progress bar, setup areas, language and font;

Step 4: displays 2/7 progress bar, jumped over directly;

Step 5: displays 3/7 progress bar, creates operating screens (invisible), initializes Icons, initializes function library;

Step 6: displays 4/7 progress bar, initializes the keyboard;

Step 7: displays 5/7 progress bar, initializes the ultrasound system, USB manager, video printer, VCR, DVD writer, file manager, iVision player etc.;

Step 8: displays 6/7 progress bar, initializes application software, including measurement, patient management, report printing, system detection, operation log, ultrasound front-end and back-end image parameters, requires POD data;

Step 9: displays 7/7 progress bar, finishes and switches to the ultrasound system operating screen.

4 Structure and Assembly/Disassembly

4.1 Explosive Figure of the Complete System

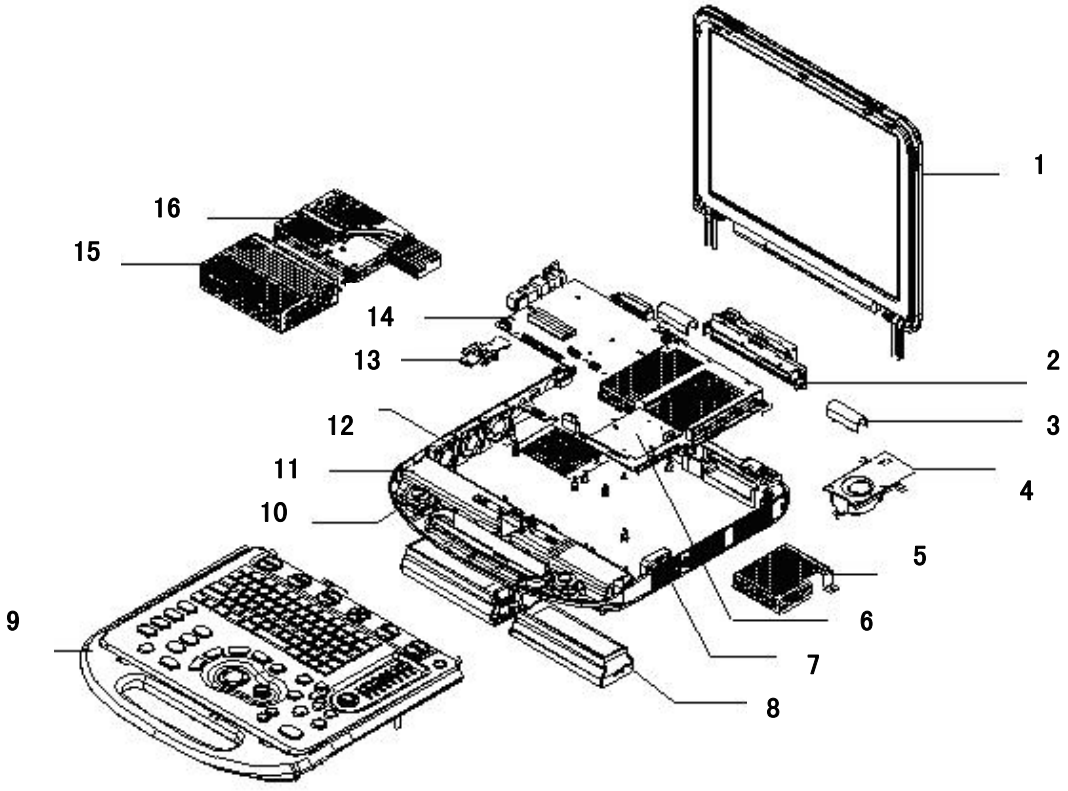


Figure 4-1 Explosive Figure

No.	Name	Part No.	No.	Name	Part No.
<1>	*display assembly*	*2108-30-65782*	<2>	*transducer board assembly*	*2108-30-65849*
<3>	*damping axis cover*	*2108-20-65736-51*	<4>	*CPU fan* *fan fixing bracket*	*2108-20-65857* *2108-20-65746*
<5>	*CW BOARD shield cover*	*2108-20-65750*	<6>	*CW board*	*2108-30-65899*

<7>	*fan and connection wire*	*2108-20-65855*	<8>	*battery*	*2108-20-65792*
<9>	*main unit top cover assembly*	*2108-30-65787*	<10>	*speaker*	*2108-20-65858*
<11>	*.main unit bottom cover*	*2108-20-66156*	<12>	*fan and connection wire (three for a group)*	*2108-20-65856*
<13>	*Battery connection board*	*2108-30-65895*	<14>	*main board*	*2108-30-65873*
<15>	*power module*	*2108-30-65791*	<16>	*CPU board and radiator module*	115-001557-00

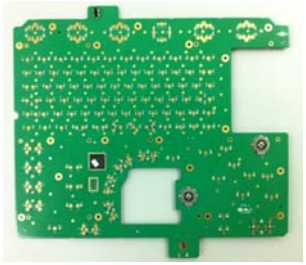
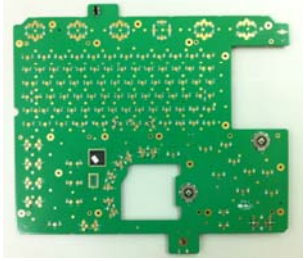
4.2 Field Replaceable Unit

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
1.1	Main unit related	Transducer board	801-2108-00015-00		M5		Refer to 4.2.13
1.2		Main board	801-2108-00001-00		M5	Includes button battery and jumper	Refer to 4.2.12
1.3		Transmitting board	801-2108-00006-00		M5		Refer to 4.2.11

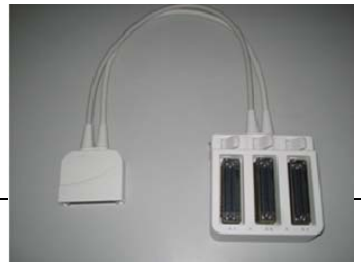
NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
1.4		CW board	801-2108-00005-00				Refer to 4.2.6
1.5		CPU module	801-2108-00067-00		M5		Refer to 4.2.8
1.6		HDD	801-2108-00048-00		M5	Mark software version(Human use or Vet), machine type(DC-3 or M5) and configuration type(CE, FDA, SFDA)when apply Not include metal support	Refer to 4.2.14
2.1	Power related	Power supply module	801-2108-00010-00		M5		Refer to 4.2.4

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
2.2		Battery connecting board	801-2108-00016-00		M5		Refer to 4.2.5
2.3		AC adapter(ECD115)	801-2108-00049-01		M5		/
2.4.1		Battery	115-010085-00		M5	For FDA Two batteries should be replaced together	Refer to 4.2.1
2.4.2		Battery	2108-30-66176		M5	For CE Two batteries should be replaced together	

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
3.1	Display related	LCD assembly	801-2108-00050-00		M5	Include LCD and adjust board. Note: adjust board should be replaced with LCD together.	Refer to 4.2.2
4.1	Control panel related	Control panel assembly	801-2108-00081-00		M5	Remark software version when apply Includes incoder,trackball,control panel PCBA,silicone rubber key etc. Not include cable	Refer to 4.2.3
4.2		TGC board	801-2108-00014-00		M5	Not include cable	Refer to 4.2.3.2

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
4.3		Trackball	801-2108-00007-00		M5	Not include cable	Refer to 4.2.3.1
4.4.1		Control panel PCBA	801-2108-00013-00		M5	Stop production,If use,plese both replace silicone rubber keypad and control panel	Refer to 4.2.3
4.4.2		Control panel PCBA(EAF196)	801-2108-00068-00		M5	If the silicone rubber keypad is 801-2108-00069-00(049-000112-00), you should apply this part.	Refer to 4.2.3

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
4.5.1		Silicon rubber keypad	801-2108-00018-00		M5	Stop production,If use,plese both replace silicone rubber keypad and control panel	Refer to 4.2.3
4.5.2		Silicon rubber keypad(EAF196)	801-2108-00069-00		M5	If the control panel PCBA is 801-2108-00068-00(051-000357-00), you should apply this part.	Refer to 4.2.3
5.1	Others	CPU fan	801-2108-00054-00		M5		Refer to 4.2.7
5.2		Single air inlet fan	801-2108-00052-00		M5		Refer to 4.2.9

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
5.3		3 in1 air inlet fan	801-2108-00053-00		M5		Refer to 4.2.9
5.4		Speaker	801-2108-00019-00		M5		Refer to 4.2.10
6.1.1	Accessories related	Data Extension Module	2108-30-66043		M5	For CE	Refer to 4.2.18
6.1.2			2108-30-66209		M5	For FDA	
6.2.1		Transducer Extension Module	2108-30-66044		M5	For CE	Refer to 4.2.15
6.2.2			2108-30-66210		M5	For FDA	

NO.	Classification	Description	Order Number	Photo	Model	Compatibility	Assembly/ Disassembly
6.3.1		Video and Audio Capture Module	2108-30-66211		M5	For CE USB Port	Refer to 4.2.17
6.3.2			2108-30-66045		M5	For CE USB Port	
6.4.1		ECG Module	2108-30-66213		M5	For FDA,AHA lead USB Port	Refer to 4.2.16
6.4.2			2108-30-66042		M5	For CE,AHA lead USB Port	
6.4.3			2108-30-66064		M5	For CE,IEC lead USB Port	
6.5		Wireless card	115-005370-00		M5		/

4.3 Structure and Assembly/Disassembly

4.3.1 Removing Battery

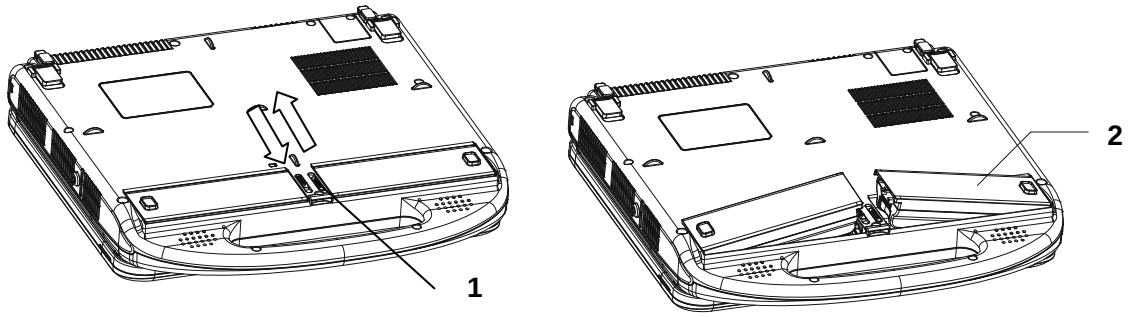


Figure 4-2 Removing Battery

No.	Name	Part No.	No.	Name	Part No.
<1>	*Battery Buckle*	*2108-20-65732*	<2>	*Battery*	*2108-20-65792*

1） As shown in Figure 4-2, push the battery buckle, and the battery pops up from the battery slot;

2） Take out the battery; left and right batteries are taken out through the same method.

4.3.2 Removing Display Assembly

1） As shown in Figure 4-3, remove screws, remove bottom cover and cable cover;

2） Disconnect display signal cable and power cord connectors.

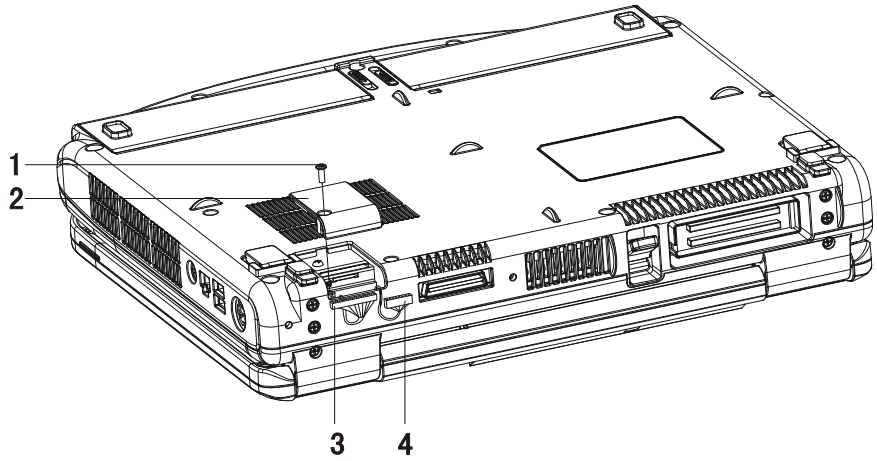


Figure 4-3 Removing Cable Cover

No.	Name	Part No.	No.	Name	Part No.
<1>	*screws M3×8*	*M04-051177---*	<2>	*Bottom cover cable cover*	*2108-20-65730-51*
<3>	*display signal cable connector*	/	<4>	*display power cord connector*	/

Caution

Display signal cable must been connected to socket on PCBA according to the correct direction. (The plug already has the function of avoiding wrong insertion and has been drew a red line on as shown in the following figure.)

Fig 1

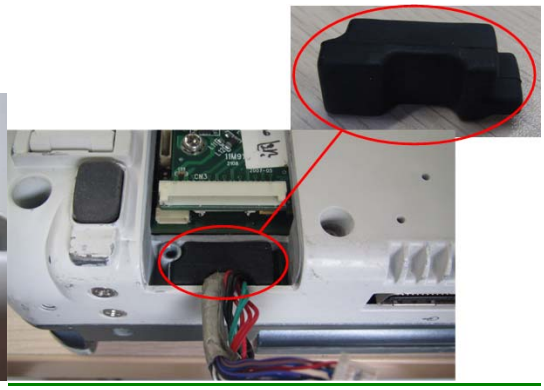


Fig 2

Note: If there is a rubber cushion in the LCD assembly, place the rubber cushion where it is during installing.

3） As shown in Figure 4-4, close the display, press down the damping axis cover to pop up the damping axis cover; take out the damping axis cover upward.

There are left and right damping axes, and they are removed with the same method.

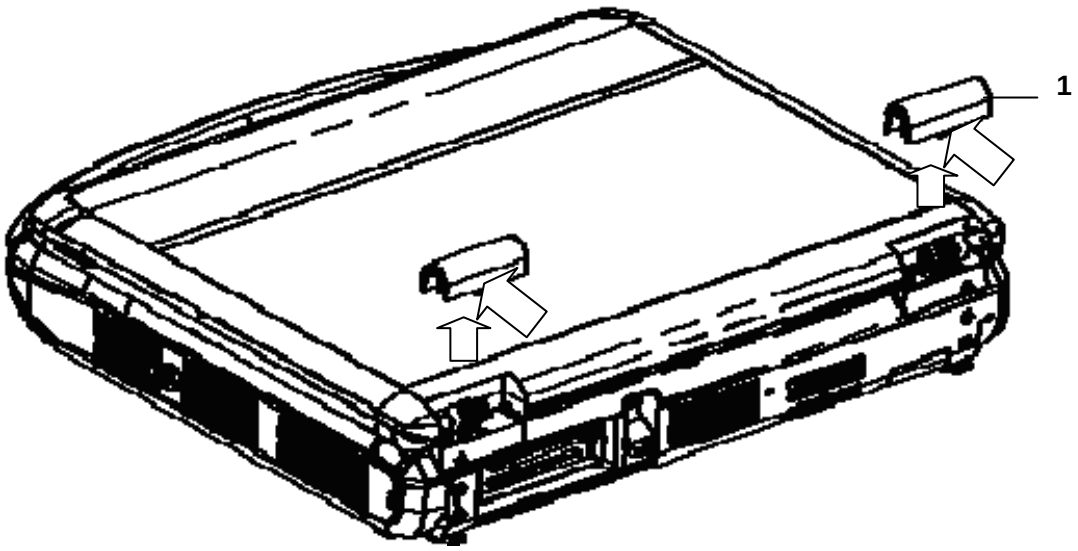


Figure 4-4 Removing the Damping Axis Cover

No.	Name	Part No.
<1>	*damping axis cover*	*2108-20-65736-51*

4） As shown in Figure 4-5, remove six M3×8 screws; take out the display assembly upward from the assembly. Note that you do not damage the display signal cable and power cord and connectors during removal.

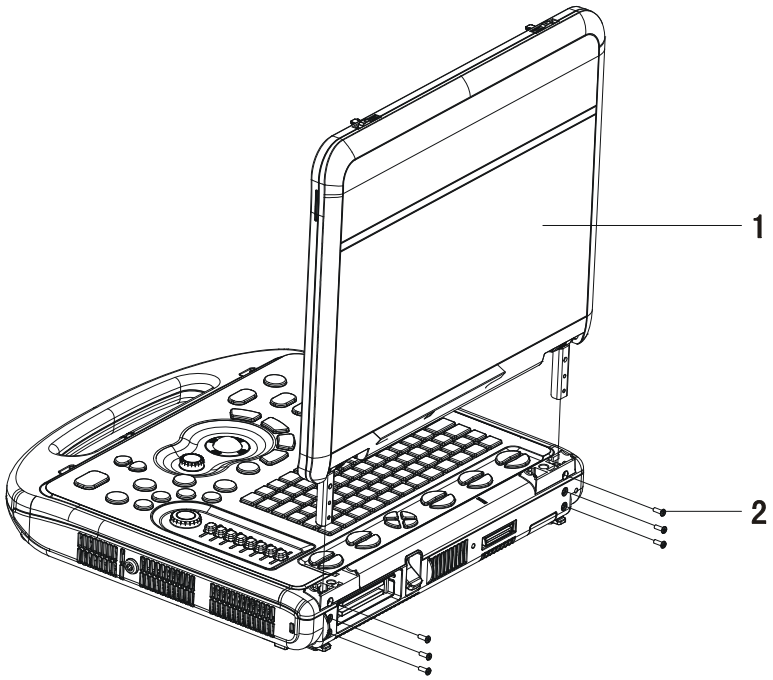


Figure 4-5 Removing the Display

No.	Name	Part No.	No.	Name	Part No.
<1>	*display assembly*	*2108-30-65782*	<2>	*screws M3×8*	*M04-051177---*

5） As shown in Figure 4-6, take out the display screw caps, remove four M3×8 screws, and take out the display front cover from the back cover.

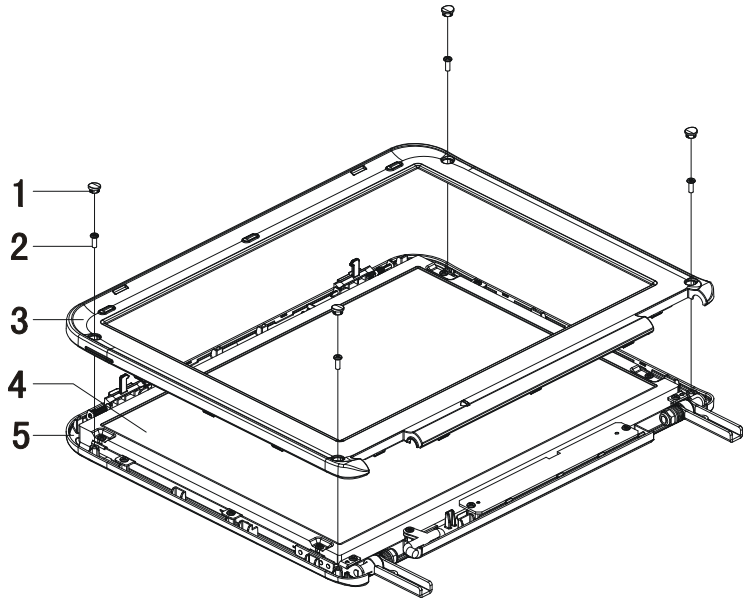


Figure 4-6 Removing Display Front Cover

No.	Name	Part No.	No.	Name	Part No.

<1>	*display screw cap*	*2108-20-65707*	<2>	*screws M3×8*	*M04-051177---*
<3>	*display front cover*	*2108-20-65705-51*	<4>	*LCD display*	*2108-10-66166*
<5>	*display back cover*	*2108-20-65706-51*			

Note: A hook is used to connect the front cover with back cover. It is recommended that you first pry the lower-left corner and lower-right corner.

6） As shown in Figure 4-7, open the seal cover for the shielding leaf of the inverter board, remove the two screws fixing the inverter board of LCD display, disconnect the power cord of LCD display backlight , and take out the inverter board. (If there is no inverter board, ignore this step.)

7） Remove one screw to loose the wire strip fixing LCD display cable and take out the cable.

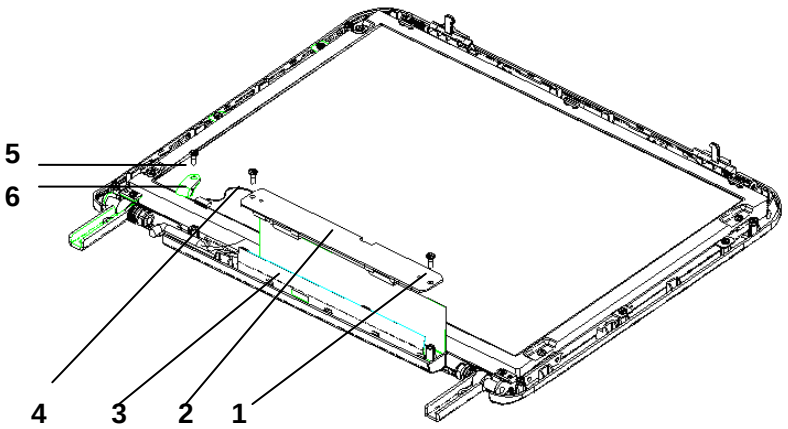


Figure 4-7 Removing Inverter Board

No.	Name	Part No.	No.	Name	Part No.
<1>	*screw M3×8*	*M04-051177---*	<2>	*LCD display backlight inverter*	*2108-10-66002*
<3>	shielding leaf of the inverter board	*2108-20-66161*	<4>	*power cord of LCD display backlight*	*2108-10-66003*
<5>	*screw M3×8*	*M04-051177---*	<6>	*wire strip*	*6200-10-09762*

8） As shown in Figure 4-8, remove four screws, and take out the LCD.

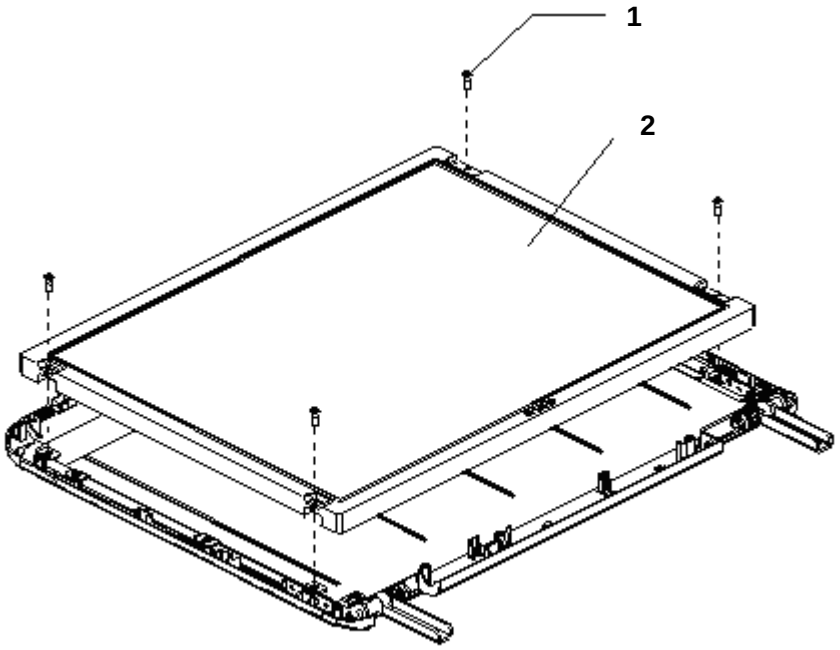


Figure 4-8 Remove LCD Display

No.	Name	Part No.	No.	Name	Part No.
<1>	*screw M3×8*	*M04-051177---*	<2>	*LCD display*	*2108-10-66166*

9） As shown in Figure 4-9, remove six screws, and take out the left and right damping axes.

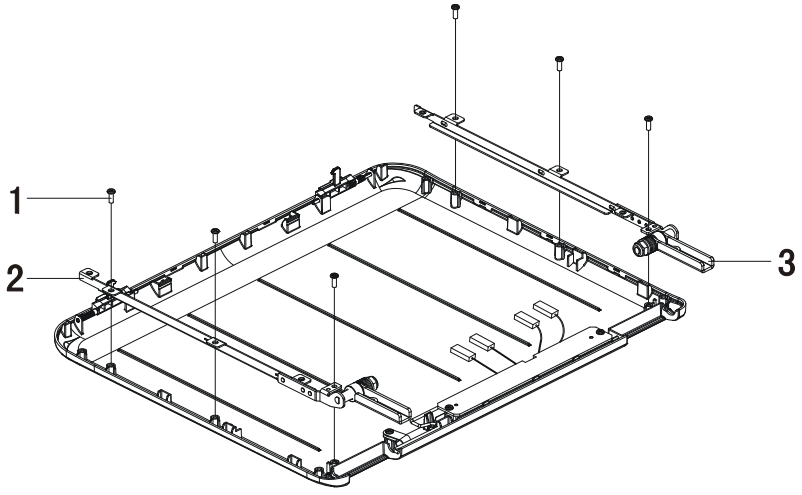


Figure 4-9 Removing left and right damping axes

No.	Name	Part No.	No.	Name	Part No.
<1>	*screw M3×8*	*M04-051177---*	<2>	*left damping axis*	*2108-20-65710*
<3>	*right damping axis*	*2108-20-65711*			

10）According to Figure 4-10, first press the spring in axial direction, wait until the shorter axis comes out, and then take out the hook upward.

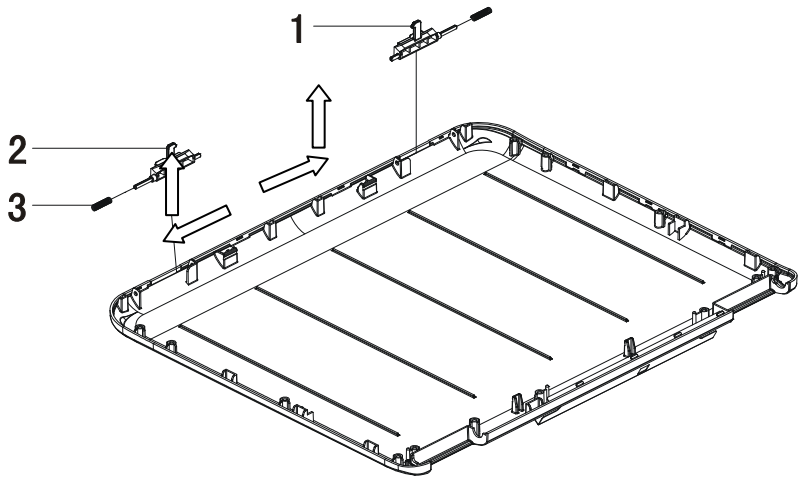


Figure 4-10 Removing the Hook

No.	Name	Part No.	No.	Name	Part No.
<1>	*right display hook*	*2108-20-65714*	<2>	*left display hook*	*2108-20-65713*
<3>	*display hook spring*	*2108-20-65715*			

4.3.3 Removing Top cover main unit

1) As shown in Figure 4-11, remove 9 screws.

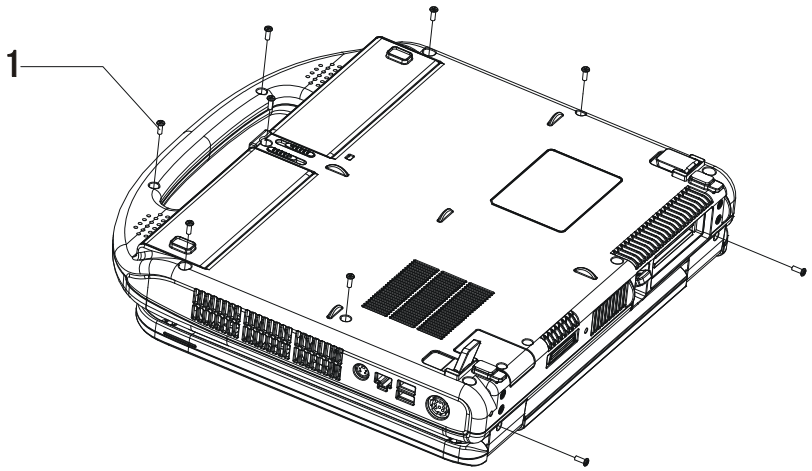


Figure 4-11 removing main unit top cover (1)

No.	Name	Part No.
<1>	*screw M3×8*	*M04-051177---*

2) As shown in Figure 4-12, lift the main unit top cover at 30 degrees, disconnect connection wire between the control panel and main board; pull it out in the direction as per the figure, and then take out the main unit top cover.

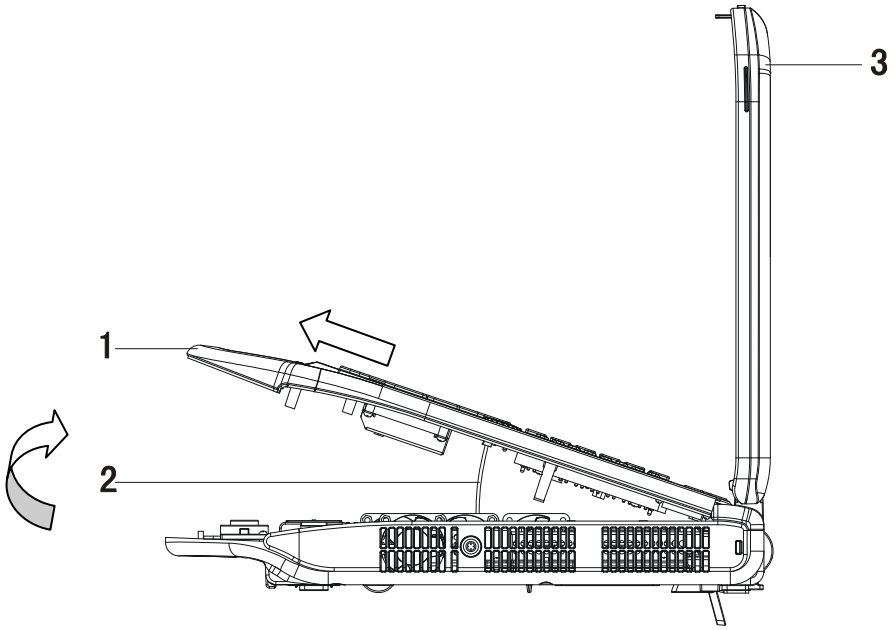


Figure 4-12 removing the main unit top cover (2)

No.	Name	Part No.	No.	Name	Part No.
<1>	*main unit top cover*	*2108-30-65787*	<2>	*Keyboard connection wire*	*2108-20-65852*
<3>	*display*	*2108-30-65782*			

4.3.3.1 Removing the Trackball

1) As shown in Figure 4-13, disconnect the trackball connection wire, loose the trackball shield cover screw to remove the trackball shield cover;

2) Remove trackball and trackball washer.

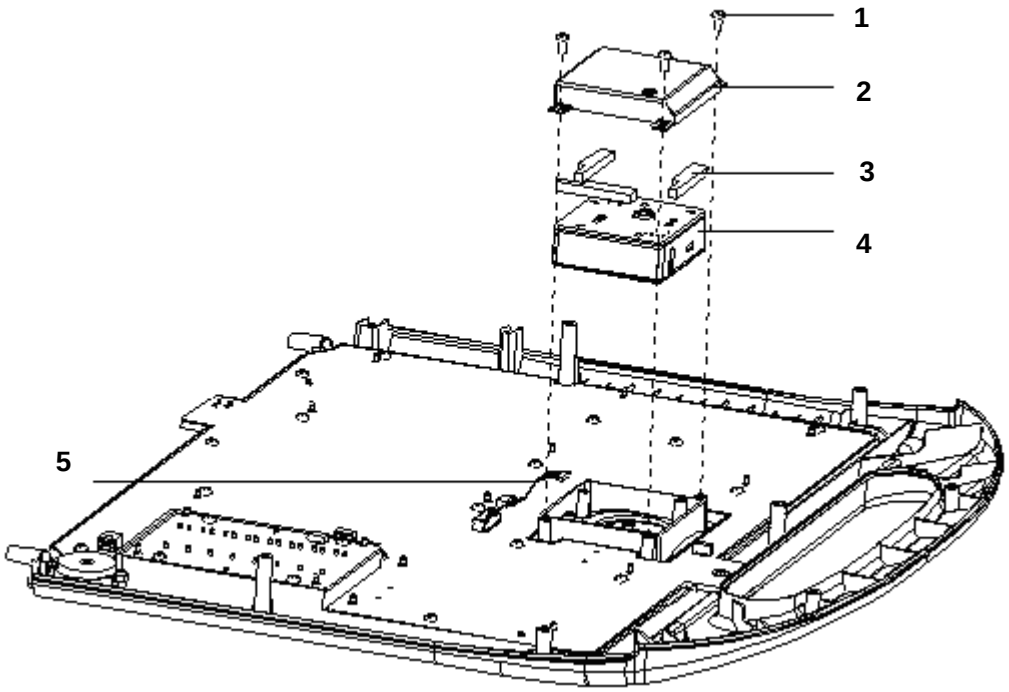


Figure 4-13 remove the trackball

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	*trackball shield cover*	*2108-20-65720*
<3>	*trackball washer*	*2108-20-65865*	<4>	*1" trackball*	*0025-30-36802*
<5>	*trackball connection wire*	*2108-20-65854*			

4.3.3.2 Removing Control Panel and TGC Board

1） As shown in Figure 4-14, remove TGC sliders, big encoder knob, small encoder knob, big encoder button, small encoder button. When removing the encoder knob, note that you shall pry it at one end of the knob.

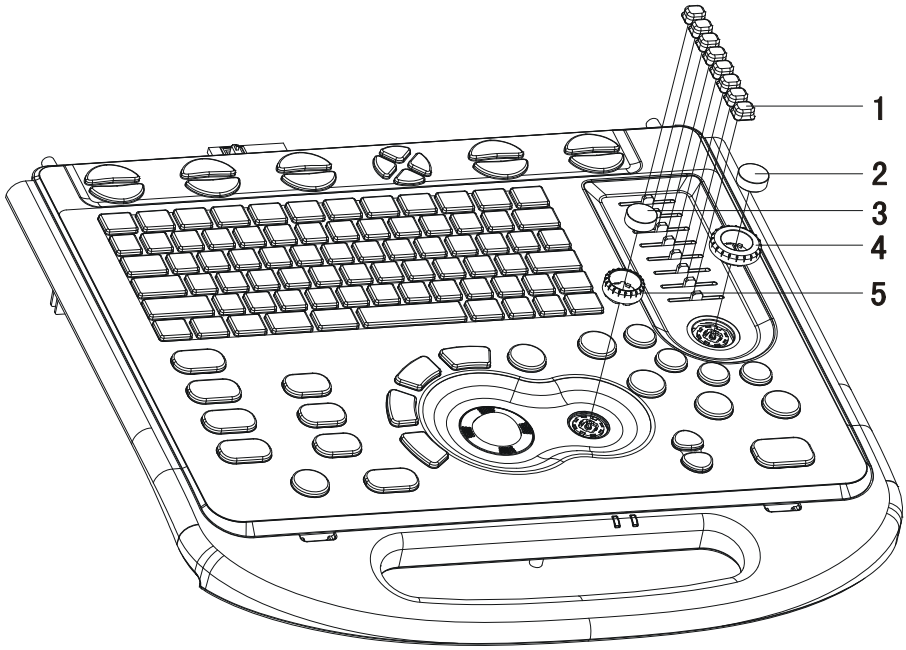


Figure 4-14 Removing TGC Sliders, Encoder Knobs and Buttons

No.	Name	Part No.	No.	Name	Part No.
<1>	*TGC slider*	*2108-20-65723*	<2>	*encoder button* (iTouch)	*2108-20-65727-51*
<3>	*encoder button*	*2108-20-65727*	<4>	*Big encoder knob*	*2108-20-65725*
<5>	*Small encoder knob*	*2108-20-65726*			

2) As shown in Figure 4-15, disconnect STC connection wire, trackball connection wire and buzzer connection wire;

3) Remove screws fixing the buzzer, and remove the buzzer;

4) Remove screws fixing the TGC adjusting board and control panel, and then remove the TGC adjusting board and control panel.

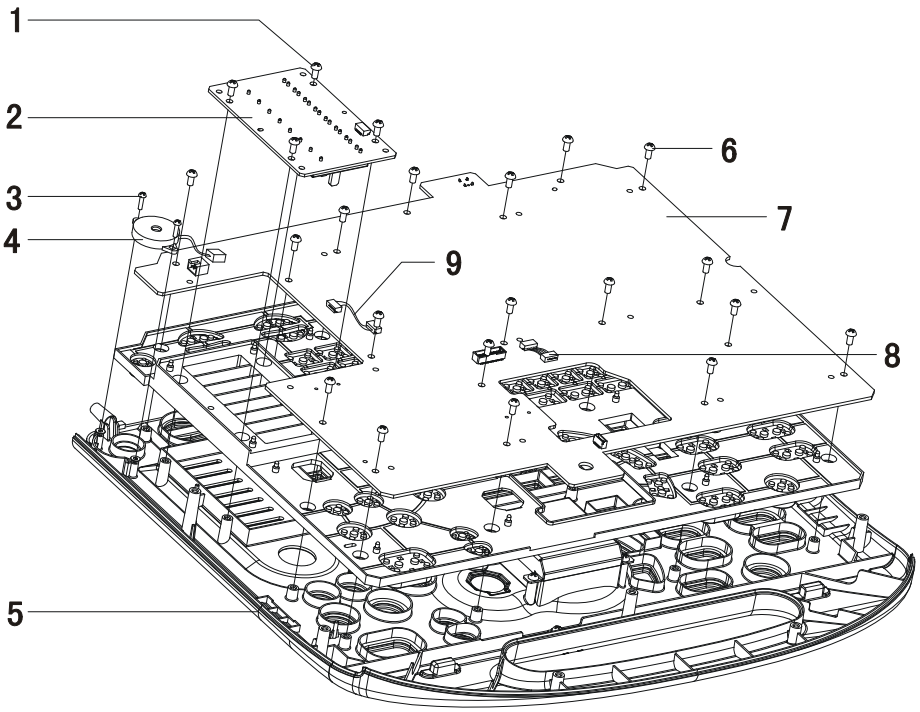


Figure 4-15 Removing TGC Adjusting Board and Control Panel

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	*TCG adjusting board*	*2108-30-65869*
<3>	*Philips panhead screw M2×8*	*M04-000805---*	<4>	*buzzer*	*2300-21-29142*
<5>	*main unit top cover*	*2108-20-65721-51*	<6>	*Philips panhead screw M3×6*	*M04-002505---*
<7>	*control panel*	*2108-30-65867*	<8>	*trackball connection wire*	*2108-20-65854*
<9>	*STC connection wire*	*2108-20-65853*			

4.3.4 Removing the Power Board

1) According to 4.3.3, remove the main unit top cover;

2) As shown in Figure 4-16, remove four M3×6 Philips panhead screws to take out the power board from the main board.

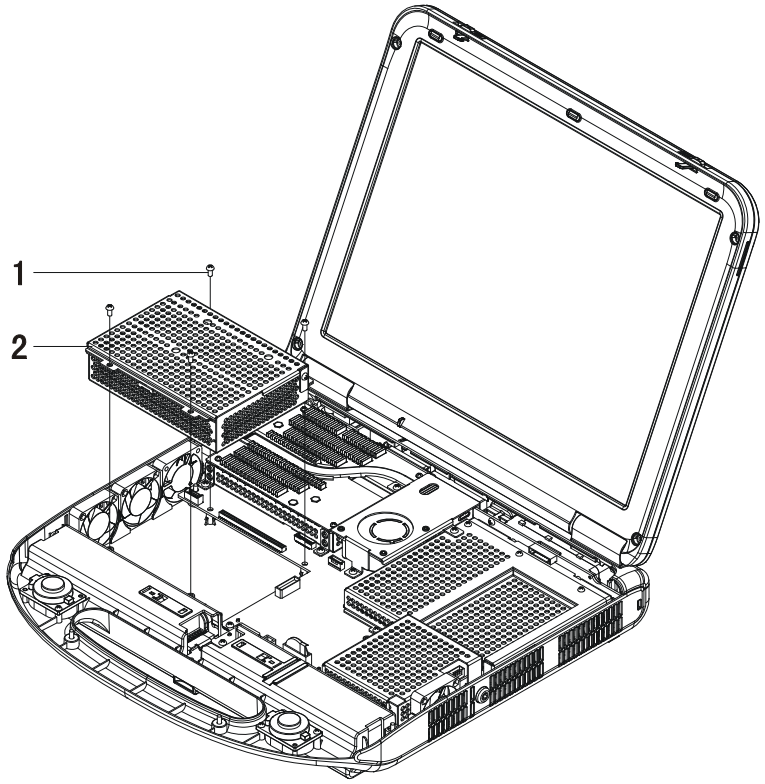


Figure 4-16 Removing Power Board

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	*Power module*	*2108-30-65791*

Note: When removing the power board, keep the power board horizontally, to prevent damaging the connector pins.

4.3.4.1 Disassembling Power Board

1) As shown in Figure 4-17, remove two screws, and remove power box top cover;

2) Remove four screws, take out the main power board, separating board and auxiliary board.

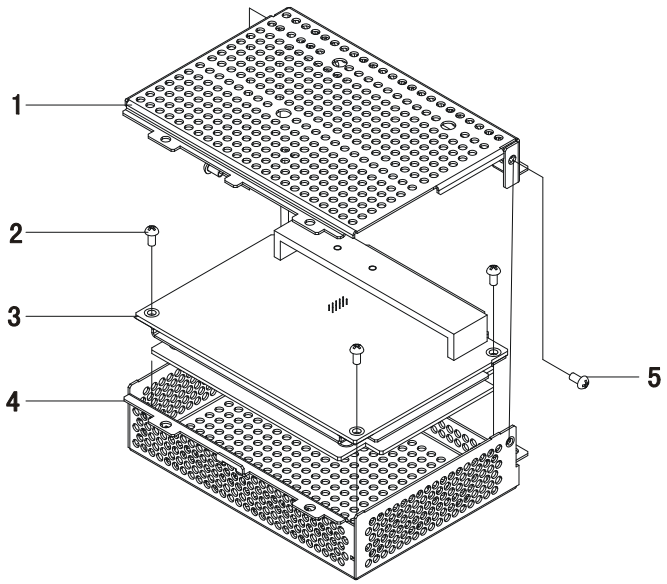


Figure 4-17 Disassembling the Power Board

No.	Name	Part No.	No.	Name	Part No.
<1>	*power box top cover*	*2108-20-65743*	<2>	*Philips panhead screw M3×6*	*M04-002505---*
<3>	*Power main board, separating board and auxiliary board*	*/*	<4>	*power box bottom cover*	*2108-20-65744*
<5>	*Philips panhead screw M3×6*	*M04-002505---*			

3) As shown in Figure 4-18, remove four screws, pull out the connectors between the main power board and auxiliary power board, and separate the main power board and auxiliary power board.

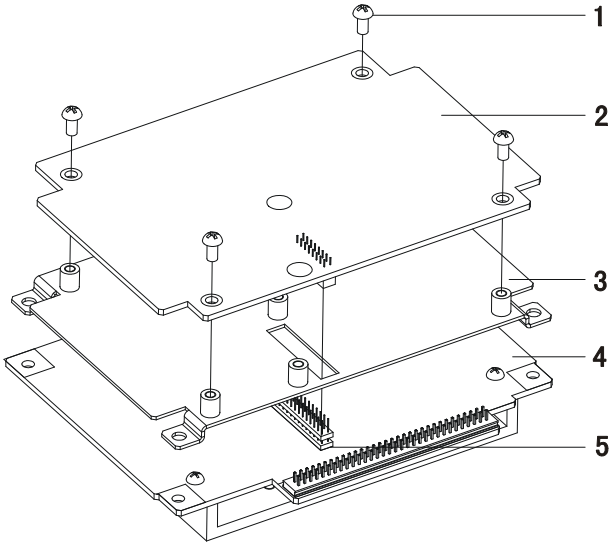


Figure 4-18 Disassembling Main Power Board, Separating Board and Auxiliary Board

No.	Name	Part No.	No.	Name	Part No.

<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	*Power auxiliary board*	*2108-30-65864*
<3>	*Power separating board*	*2108-20-65745*	<4>	*Power main board*	*2108-30-65862*
<5>	*Connector of power main board*	/			

4.3.5 Removing Battery Connection Board

1） According to 4.3.3, remove the main unit top cover;

2） As shown in Figure 4-19, remove Philips panhead screw 1, and disconnect the battery socket pressing board and battery connection board from the main board.

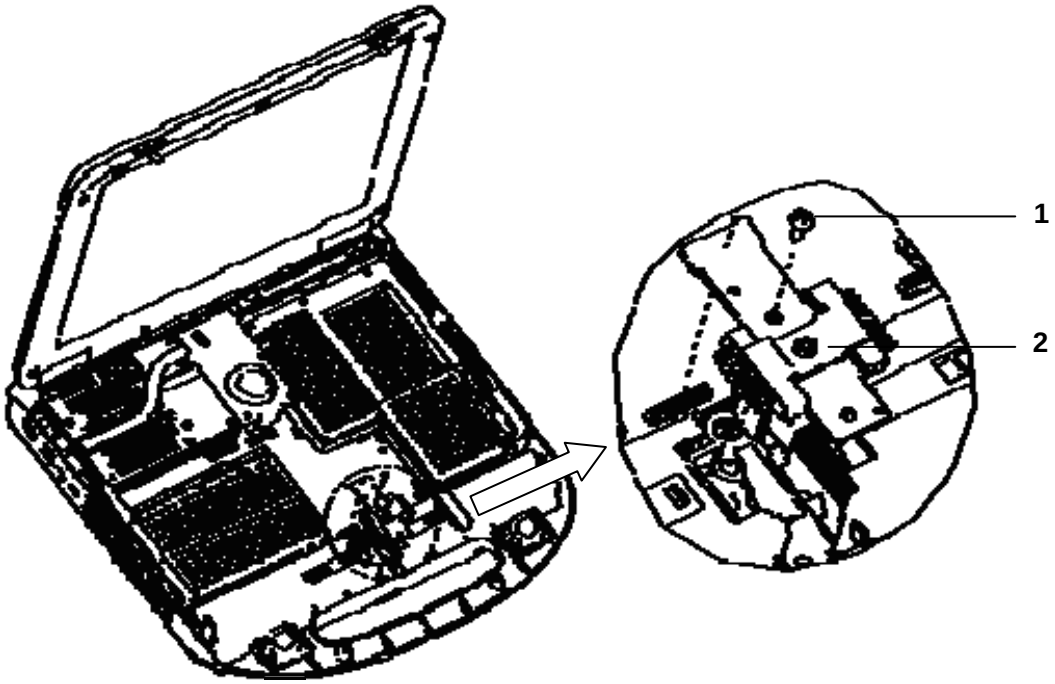


Figure 4-19 Removing Battery Connection Board

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	*Battery connection board*	/

3） As shown in Figure 4-20, take out Philips panhead screw 1, and separate the battery socket pressing board from the battery connection board.

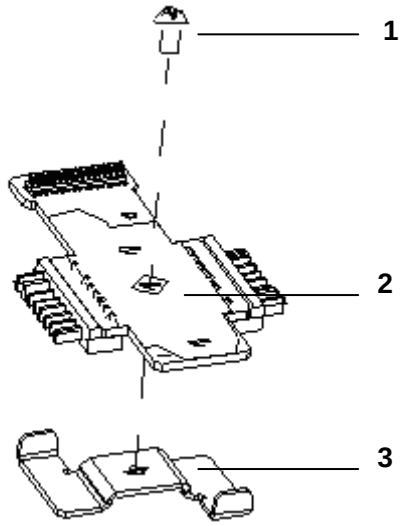


Figure 4-20 Removing Battery Socket Pressing Board

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	*Battery connection board*	*2108-30-65895*
<3>	*Battery socket pressing board*	*2108-20-65990*			

4.3.6 Removing Continuous Wave Doppler Board

1） As shown in Figure 4-21, remove four Philips panhead screws 1, and remove the CW board shield cover.

2） Remove two Philips panhead screws 3 fixing the continuous wave Doppler board, and take out the continuous wave Doppler board upward.

Note: If a pencil probe is configured with the system, you shall first disconnect the pencil probe connector before removing the continuous wave Doppler board.

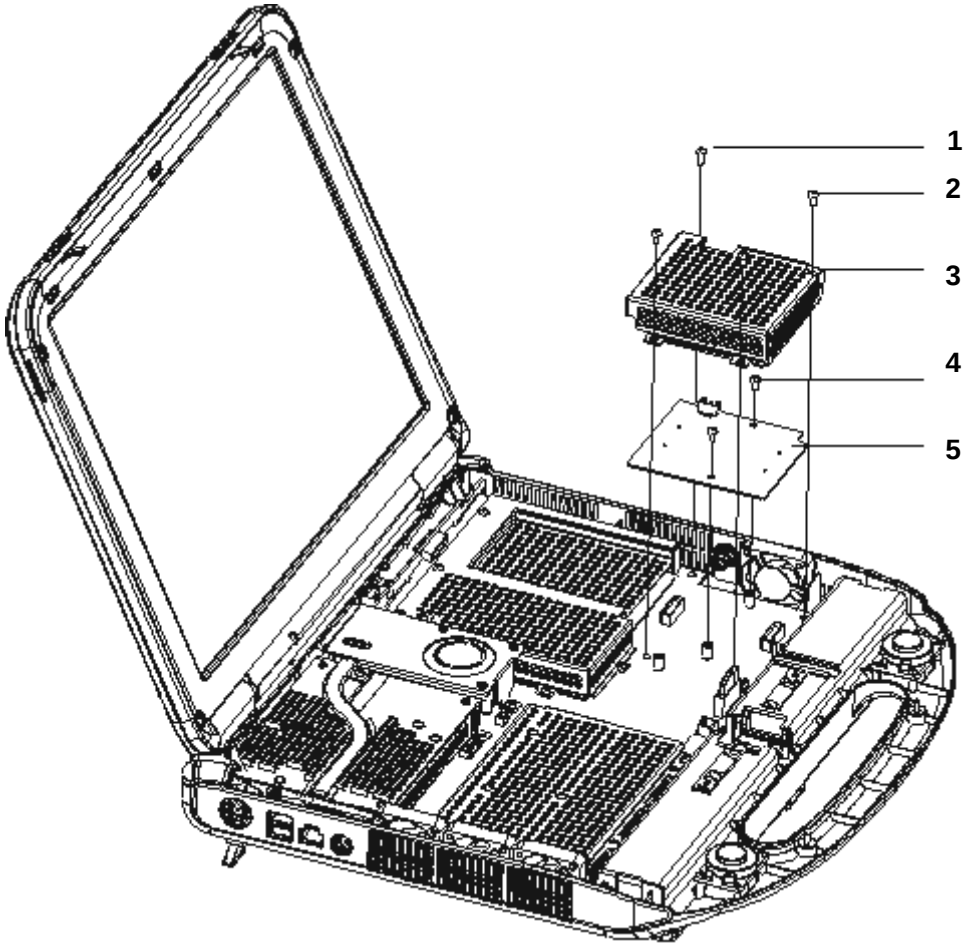


Figure 4-21 Removing CW Board

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M2.5X8*	*M04-051121---*	<2>	*Philips panhead screw M3×6*	*M04-002505---*
<3>	*CW board shield cover*	*2108-20-65750*	<4>	*Philips panhead screw M3×6*	*M04-002505---*
<5>	*CW board*	*2108-30-65899*			

4.3.7 Removing CPU Fan

1） According to 4.3.3, remove the main unit top cover;

2） As shown in Figure 4-22, pull out the CPU fan connector,

3） Remove three screws of fan fixing bracket, and remove fan fixing bracket and CPU fan and connection wire from the main board;

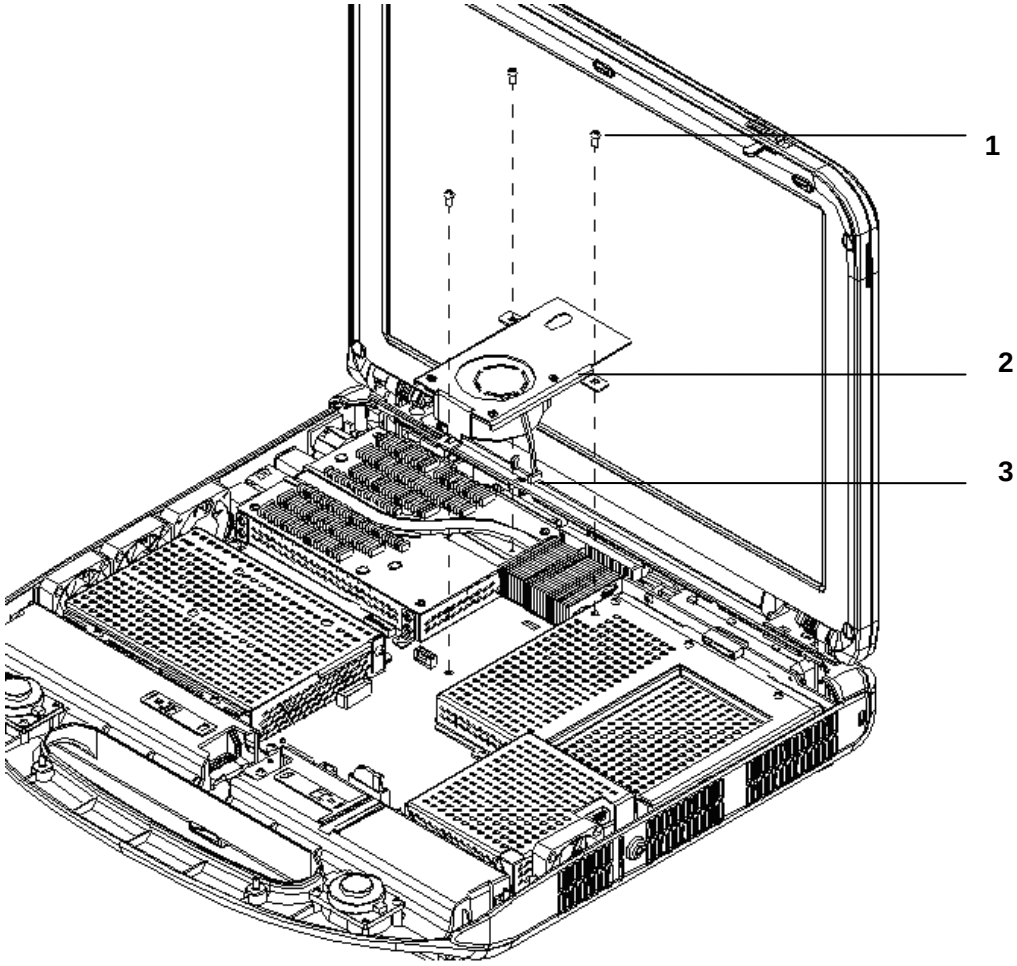


Figure 4-22 remove CPU fan

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	*CPU fan and fixing bracket*	/
<3>	*CPU fan connector*	/			

4） Remove three screws of CPU fan, and take out the CPU fan.

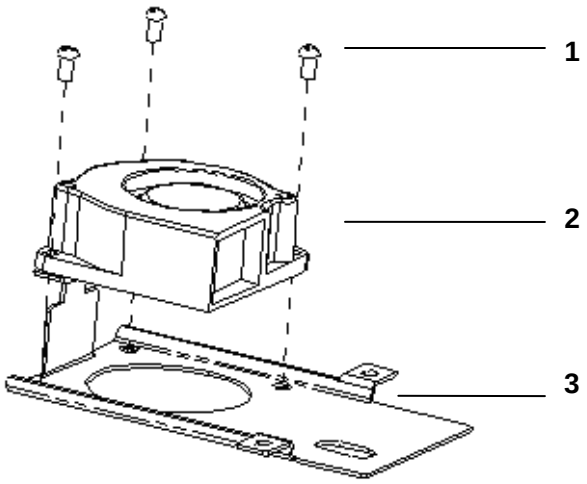


Figure 4-23 Removing Fan Fixing Bracket

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	*CPU fan and connection wire*	*2108-20-65857*
<3>	*fan fixing bracket*	*2108-20-65746*			

4.3.8 Removing CPU Board and Radiator Module

1) According to 4.3.3, remove the main unit top cover;

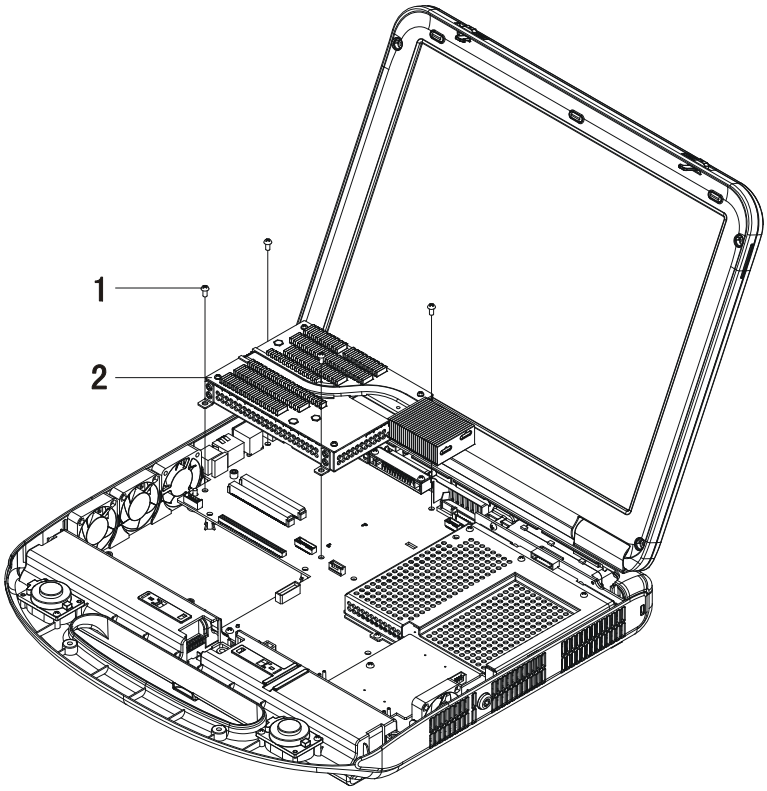


Figure 4-24 Removing CPU Board (760A) and Radiator Module

2) As shown in Figure 4-24, first remove the four M3×6 Philips panhead screws, and then disconnect CPU board and radiator module from the main board;

No.	Name	Material number	No.	Name	Material number
<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	*CPU board (760A) and Radiator module*	*115-003725-00*

3) As shown in Figure 4-25, remove the four M2×10 Philips panhead screws on the CPU board bracket.

4) Remove the three M2.6×10.5 slotted panhead plastic screws securing the CPU board and radiator.

5) Remove the three M2.5×8 Philips panhead screws securing the radiator and CPU Board.

6）Remove CPU board bracket and separate the radiator from CPU board.

7）Remove the heat-conducting washer on the two industrial control boards.

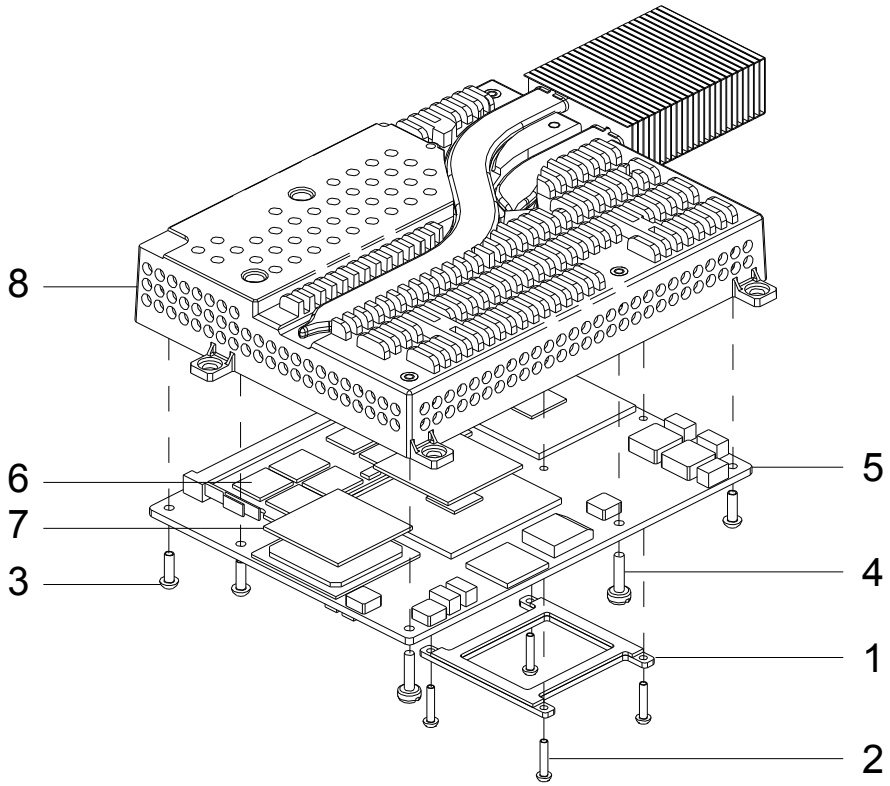


Figure 4-25 Removing CPU Board

No.	Name	Material number	No.	Name	Material number
<1>	*CPU board bracket*	*042-000001-00*	<2>	Philips panhead screw *M2×10*	*M04-051020---*
<3>	*Philips panhead screw M2.5×8*	*M04-051121---*	<4>	Slotted panhead plastic screw *M2.6X10.5*	*M04-051136---*
<5>	*Industrial control main board CE760A with BIOS software (dedicated for Mindray)*	*023-000040-00*	<6>	*Memory bank (1GB, DDR2-667PC2-5300, usually for notebook)*	*0000-10-11256*
<7>	Heat-conducting washer	*047-000210-00*	<8>	*Radiator (M5)*	*045-000062-00*

Notes: when assemble the module, first fix the heat-conducting washer and memory bank onto the industrial control board, install the board onto the radiator (M5), then secure the CPU board bracket with four Philips panhead screws M2×10, and then fix the three M2.5×8 Philips panhead screws. When finished the installation of CPU and radiator as described above, install the whole module onto the main board correctly, then secure the module with the main board using four M3×6 panhead screws.

4.3.8.1 Removing Memory Stick

Move the buckles of the memory stick outside, and the memory stick will automatically pop up, and take out the memory stick.

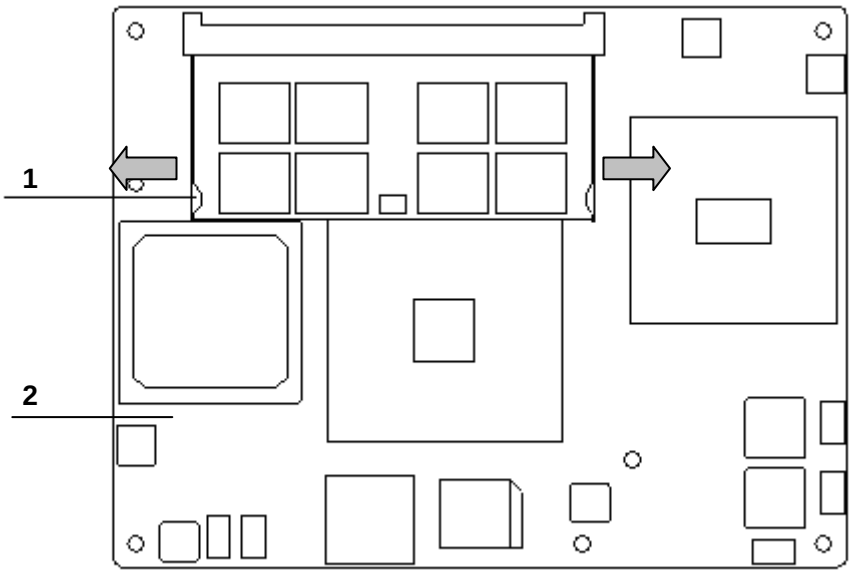


Figure 4-26 Removing Memory Stick

No.	Name	Part No.	No.	Name	Part No.
<1>	*memory stick*	*0000-10-11256*	<2>	*CPU board*	023-000040-00

4.3.9 Removing the System Fan

1） According to 4.3.3, remove main unit top cover;

2） As shown in Figure 4-27, pull out connectors between the system fan, main board, and CPU fan;

3） Pull out the fan from the main unit bottom cover in the vertical direction.

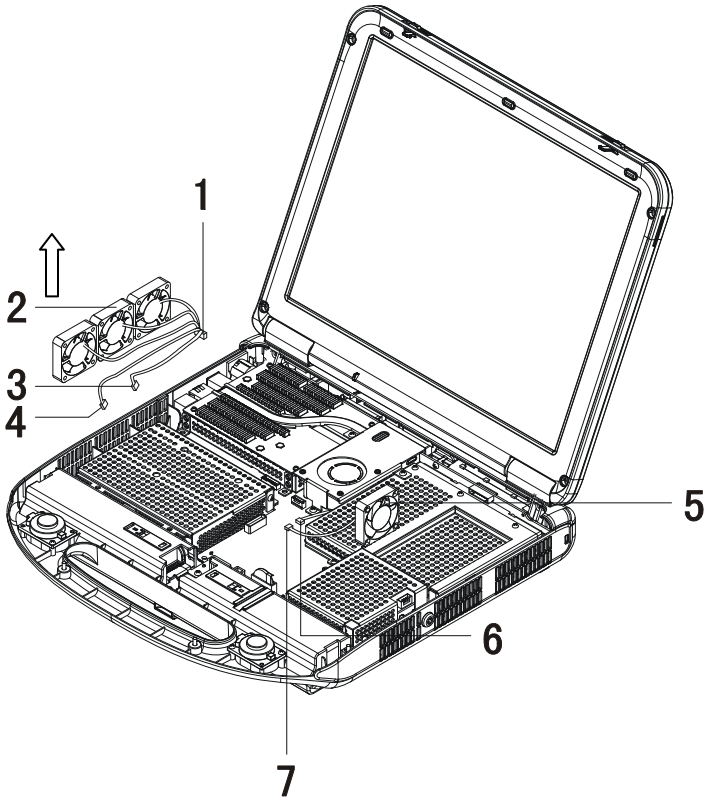


Figure 4-27 Removing System Fan

No.	Name	Part No.	No.	Name	Part No.
<1>	Connectors between the fan and main board	/	<2>	fan and connection wire (three in a group)	2108-20-65856
<3>	fan connector (connected to 6)	/	<4>	fan connector (connected to 7)	/
<5>	fan and connection wire	2108-20-65855	<6>	fan connector (connected to 3)	/
<7>	fan connector (connected to 3)	/			

Note: When you reinstall the fans, note that the four system fans shall blow wind inside (the brand shall face to the inside); verify that all fans can rotate normally.

4.3.10 Removing Speakers

1） According to 4.3.3, remove the main unit top cover;

2） As shown in Figure 4-28, disconnect the speaker connectors;

3） Remove the four (2×2) M2.5×8 screws, and remove the speakers.

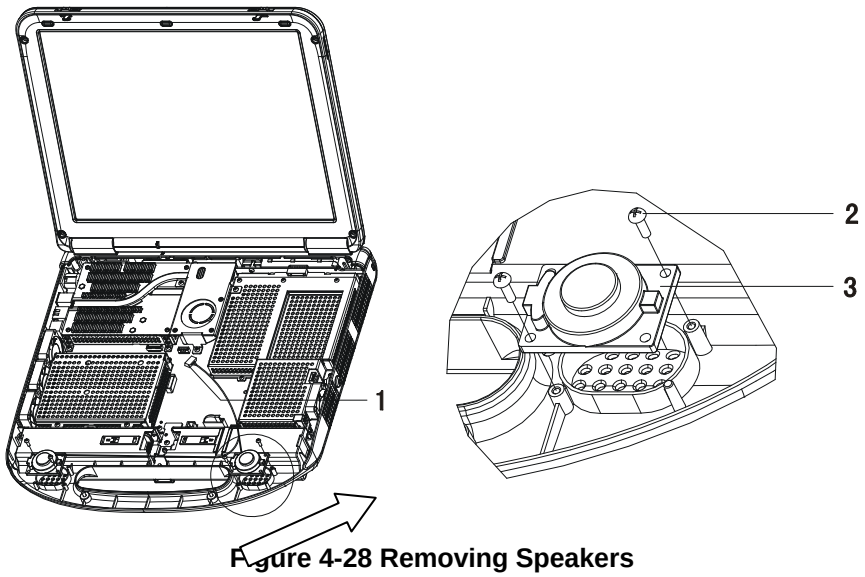


Figure 4-28 Removing Speakers

No.	Name	Part No.	No.	Name	Part No.
<1>	*Speaker connector*	*/*	<2>	*Philips panhead screw M2.5×8*	*M04-051121---*
<3>	*speaker and connection wire*	*2108-20-65858*	<4>		

4.3.11 Removing Transmission Board

1） According to 4.3.3, remove the main unit top cover;

2） According to 4.3.6, remove the continuous wave Doppler board;

3） As shown in Figure 4-29, remove seven M2.5×8 Philips panhead screws and one M3×6 Philips panhead screw;

4） Remove the main board top shield cover;

5） Remove two screws fixing the transmission board, disconnect transmission board. Note that transmission board and main board are connected by four connectors, so use force evenly.

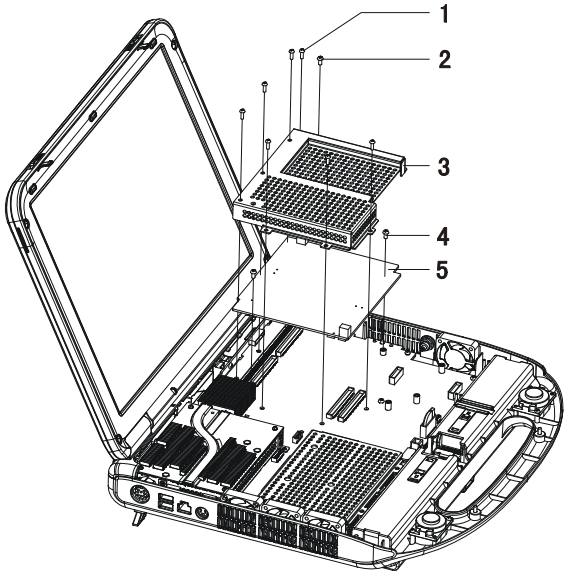


Figure 4-29 Removing Transmission Board

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M2.5×8*	*M04-051121---*	<2>	*Philips panhead screw M3×6*	*M04-002505---*
<3>	*main board top shield cover*	*2108-20-65747*	<4>	*Philips panhead screw M3×6*	*M04-002505---*
<5>	*Transmission board*	*2108-30-65889*			

4.3.12 Removing Main Board and Transducer Board

1） Remove one M3X8 screw as shown in Figure 4-30.

2） According to steps 1) and 2) in 4.3.1, remove bottom cover cable cover, disconnect display signal cable and power cord;

3） According to 4.3.3, remove the main unit top cover;

4） According to 4.3.4, remove power board;

5） According to 4.3.5, remove battery connection board;

6） According to step 1) in 4.3.6, remove CW board shield cover;

7） According to 4.3.7, remove CPU fan;

8） According to 4）, remove CPU board and radiator module;

9） According to step 1) in 4.3.9, pull out connectors between the system an and main board;

10） According to step 1) in 4.3.10, pull out connectors between speaker and main board;

11） As shown in Figure 4-31, remove four M3×6 screws, move the transducer lever facing upward, and lift the main board upward at 30 degrees;

12） Remove the main board and transducer board.

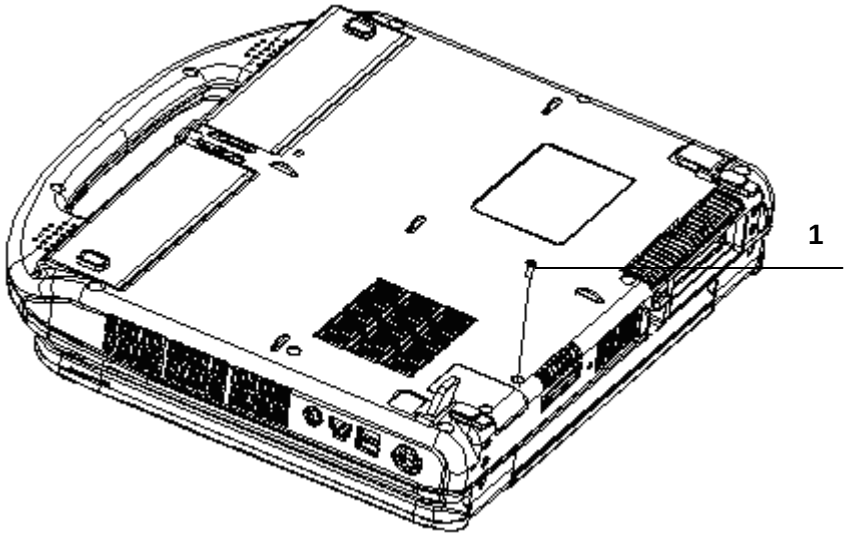


Figure 4-30 Removing Main Board and Transducer Board (1)

No.	Name	Part No.
<1>	*screw M3×8*	*M04-051177---*

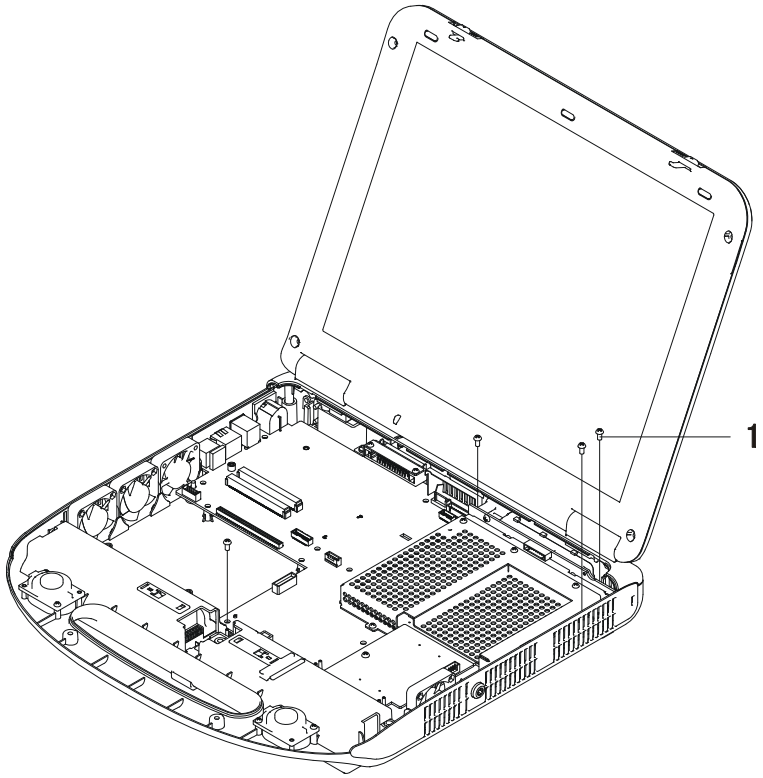


Figure 4-31 Removing Main Board and Transducer Board (2)

No.	Name	Part No.
<1>	*Philips panhead screw M3×6*	*M04-002505---*

4.3.13 Removing Transducer Board

1) According to 4.3.12, remove main board and transducer board;

2) As shown in Figure 4-32, remove seven screws fixing transmission board shield cover; remove main board top shield cover and main board bottom shield cover.

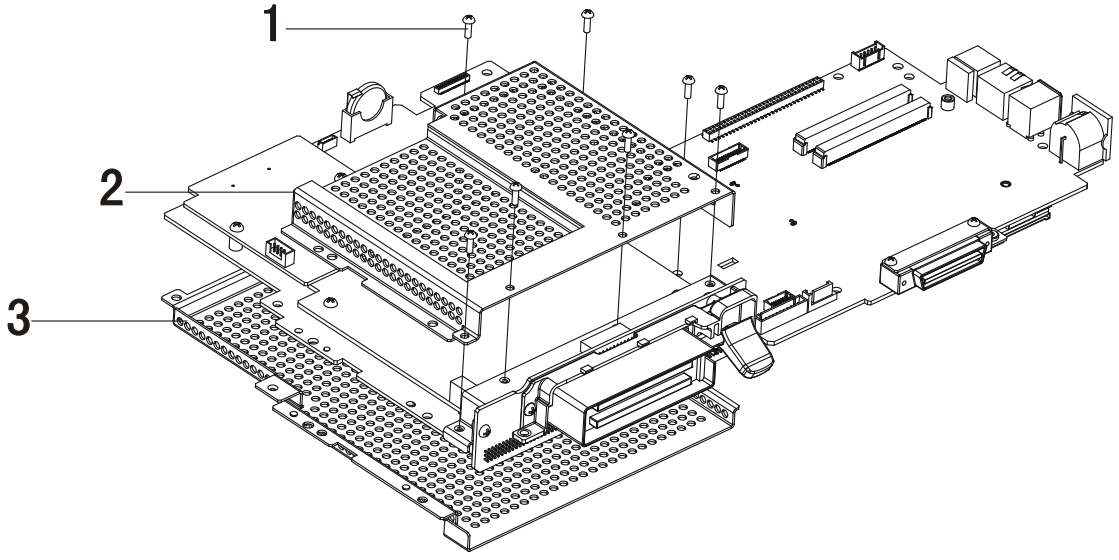


Figure 4-32 Removing Transducer Board (1)

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M2.5×8*	*M04-051121---*	<2>	*main board top shield cover*	*2108-20-65747*
<3>	*main board bottom shield cover*	*2108-20-65748*			

3) As shown in

Figure 4-33, pull out the transducer board from the main board by both hands, use force evenly, and prevent damaging the connector pins.

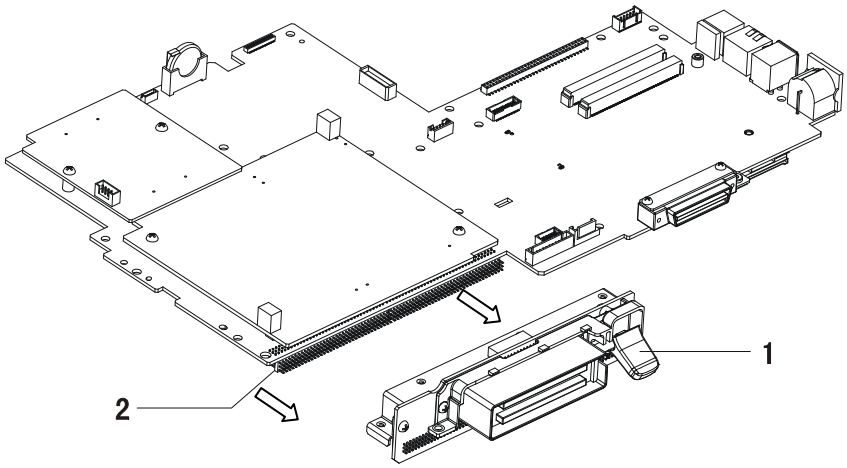


Figure 4-33 Removing Transducer Board (2)

No.	Name	Part No.	No.	Name	Part No.
<1>	*transducer board*	*2108-30-65849*	<2>	*main board transducer connector*	/

4.3.14 Removing HDD

NOTE please pay attention to the following matters during isassembling/assembling, otherwise the hard disk will be damaged:

- Hold the side of the hard disk, and please do not touch the board of the hard disk.
- Fasten the screws with the handy screw driver, and do not with the electric screw driver.
- The torsion value of the screw lock is:

  M3: 4 to 6 kgf.cm

  M4: 6 to 8 kgf.cm

1) According to 4.3.12, remove main board and transducer board;

2) As shown in Figure 4-34, remove M3×6 screw, and pull out the HDD and HDD fixing part horizontally;

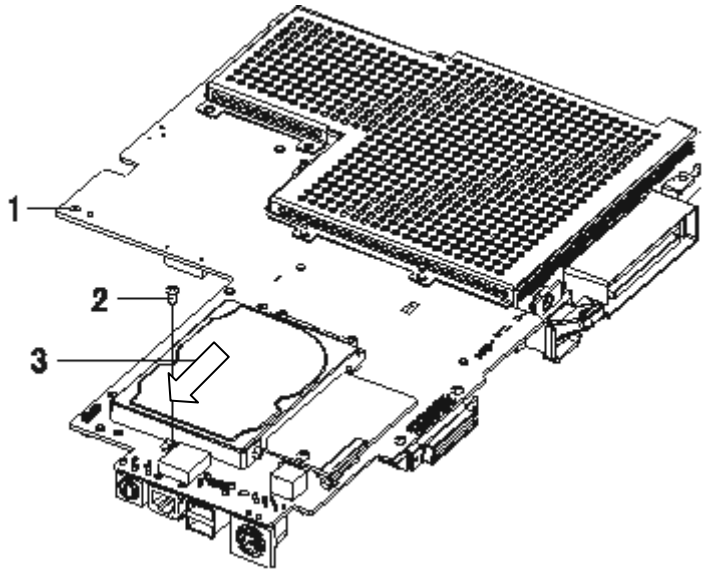


Figure 4-34 Removing HDD

No.	Name	Part No.	No.	Name	Part No.
<1>	*main board*	*2108-30-65873*	<2>	*Philips panhead screw M3×6*	*M04-002505---*
<3>	*HDD*	*023-000045-00*			

3) As shown in Figure 4-35, remove two M3×4 screws, and separate the HDD fixing part, and remove HDD.

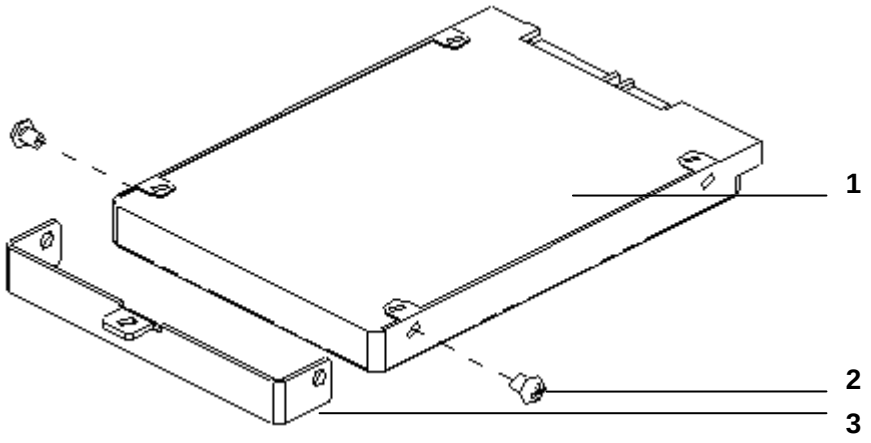


Figure 4-35 Removing HDD Fixing Part

No.	Name	Part No.	No.	Name	Part No.
<1>	*HDD*	*023-000045-00*	<2>	*Philips panhead screw M3×4*	*M04-051001-01*
<3>	*HDD fixing part*	*2108-20-65752*			

4.3.15 Removing Transducer Extension Module

1） As shown in Figure 4-36, remove four M3×6 Philips panhead screws, and remove the fixing board of the transducer extension module.

2） Remove four M3×6 Philips panhead screws, remove the bottom cover of the transducer extension module.

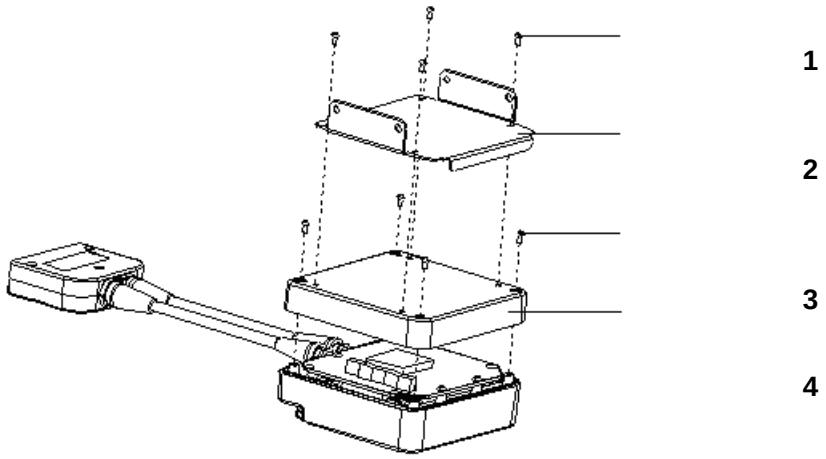


Figure 4-36 Removing Transducer Extension Module (1)

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	*transducer extension module fixing board*	*2108-20-65757*
<3>	*Philips panhead screw M3×6*	*M04-002505---*	<4>	*transducer extension module bottom cover*	*2108-20-65769-51*

3） As shown in Figure 4-37, remove three M3×6 Philips panhead screws.

4） Pull out B transducer extension board vertically and upward, and separate it from socket in the A transducer extension board.

5） Disconnect the connection board on the transducer extension module socket of the B transducer extension board, and remove B transducer extension board.

6） Hold the transducer wire sheath and pull it out vertically, and remove the extension module socket.

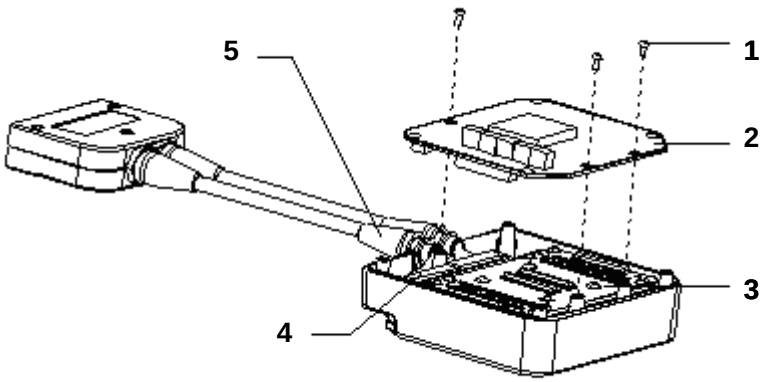


Figure 4-37 Removing Transducer Extension Module (2)

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	*B transducer extension module*	*2108-30-65887*
<3>	*A transducer extension module*	*2108-30-65885*	<4>	*connection board*	*/*
<5>	*transducer extension module socket*	*2108-30-65800*			

7） As shown in Figure 4-38, remove two M2×4 Philips sunk screws, and pull out the transducer lever.

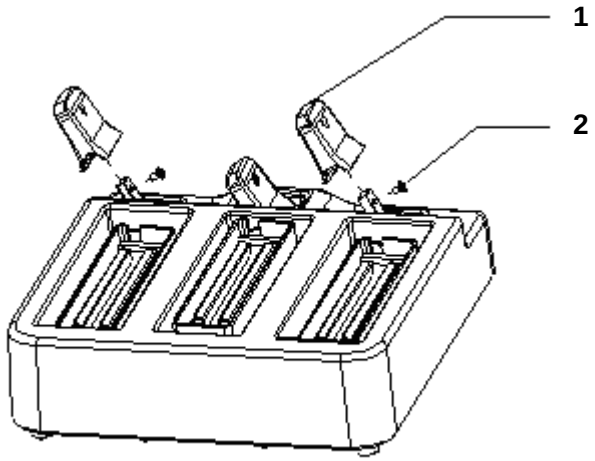


Figure 4-38 Removing Transducer Extension Module (3)

No.	Name	Part No.	No.	Name	Part No.
<1>	*transducer lever*	*2108-20-65735*	<2>	*Philips sunk screw M2×4*	*M04-006005---*

8） As shown in Figure 4-39, remove 8 M3×6Philips panhead screws, and carefully pull out the A transducer extension board

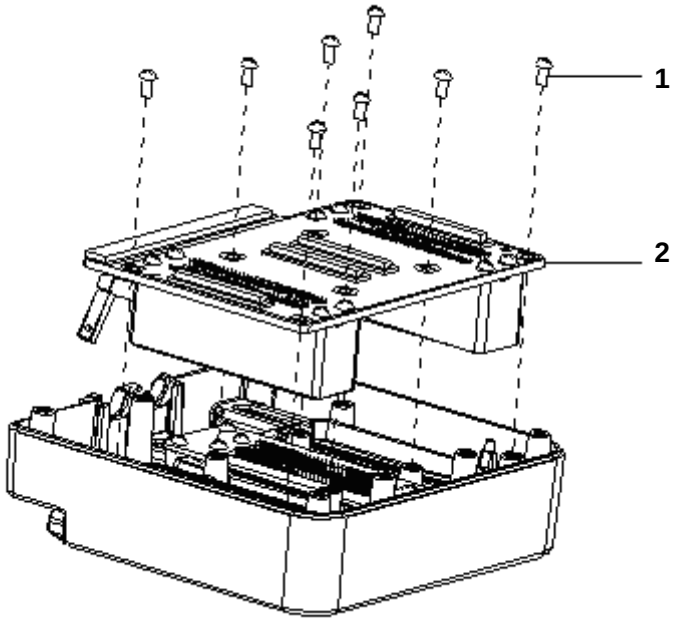


Figure 4-39 Removing Transducer Extension Module (4)

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	*A transducer extension module*	*2108-30-65885*

9) As shown in step 7), remove the transducer lever.

10) As shown in Figure 4-40, remove 4 M3×6 Philips panhead screws, and remove the transducer bracket.

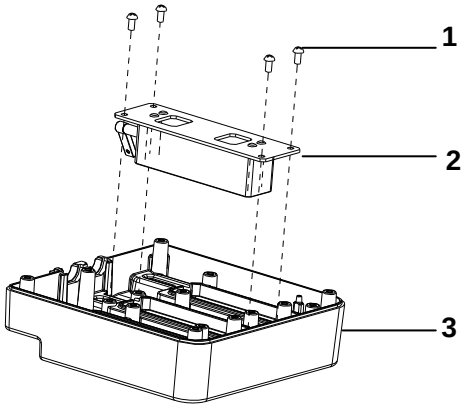


Figure 4-40 Removing transducer bracket

No.	Name	Part No.	No.	Name	Part No.
<1>	*Philips panhead screw M3×6*	*M04-002505---*	<2>	transducer bracket	*2108-30-66217*
<3>	*Cover for transducer extension module*	*2108-20-65768-51*			

4.3.16 Removing ECG Module

1) As shown in Figure 4-41, use tweezers to take out four connector enclosure screw caps (use care not to scratch the enclosure), remove four M3X8 screws, and remove ECG module top cover.

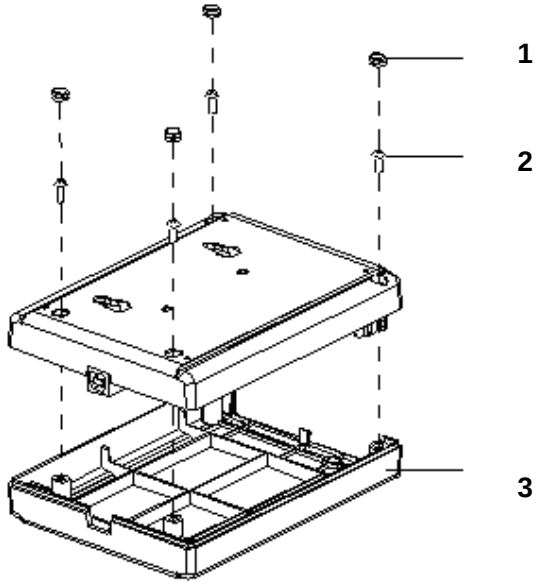


Figure 4-41 Removing ECG Module Enclosure

No.	Name	Part No.	No.	Name	Part No.
<1>	*Enclosure screw cap*	*PR1E-20-43959*	<2>	*Screw M3X8*	*M04-051177---*
<3>	*ECG module top cover*	*2108-20-65842-51*			

2) As shown in Figure 4-42, remove two M3X8 screws, disconnect connector of the ECG module internal signal cable, and remove the ECG board.

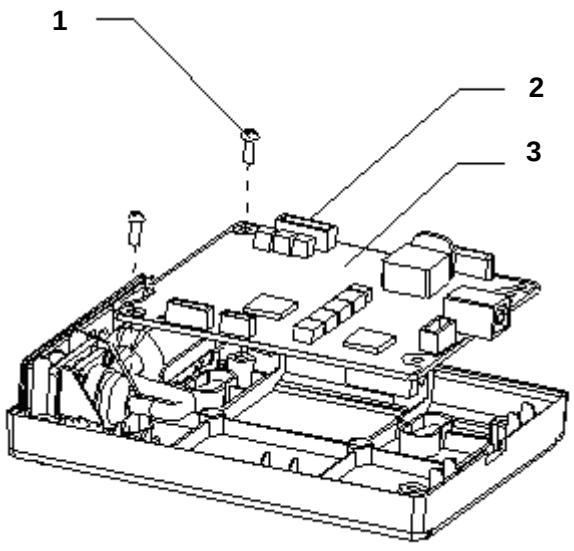


Figure 4-42 Removing ECG Board

No.	Name	Part No.	No.	Name	Part No.
<1>	*Screw M3X8*	*M04-051177---*	<2>	*signal cable socket*	/
<3>	*ECG board*	*2108-30-65897*			

3) As shown in Figure 4-43, remove three M3X6 Philips panhead screws;

4) Remove four M2X8 Philips panhead tapping screws and flat washers;

5) Cut off two wire strips on the magnetic ring, and remove ECG module internal signal cable.

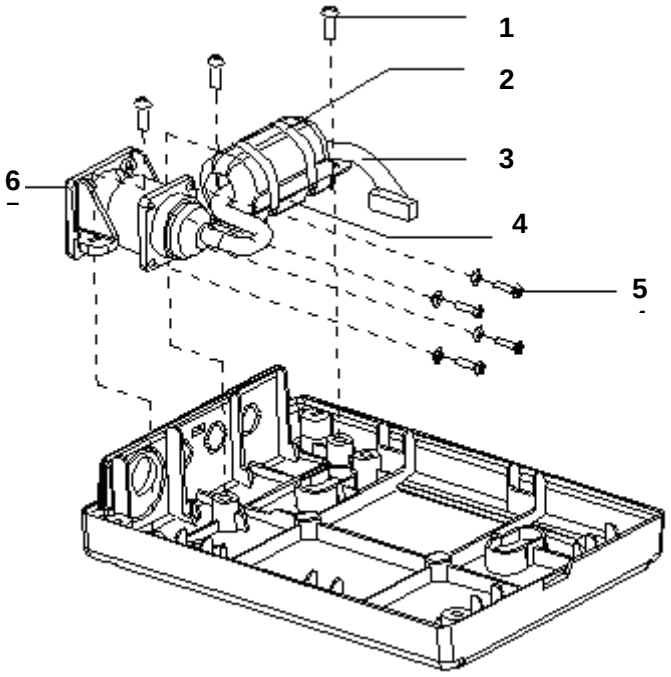


Figure 4-43 Removing ECG Module Internal Signal Cable

No.	Name	Part No.	No.	Name	Part No.
<1>	*screws M3X8*	*M04-051177---*	<2>	*wire strip*	*M6P-050005---*
<3>	*ECG module internal signal cable*	*2108-20-65850*	<4>	*fixing part of magnetic ring*	*2108-20-65844*
<5>	*Philips panhead tapping screw PT2X8 and flat washer*	/	<6>	*fixing part of ECG socket*	*2108-20-65845*

4.3.17 Removing Video and Audio Capture Module

1） As shown in Figure 4-44, use tweezers to take out four connector enclosure screw caps (use care not to scratch the enclosure);

2） Remove four M3X8 screws, and remove the top cover.

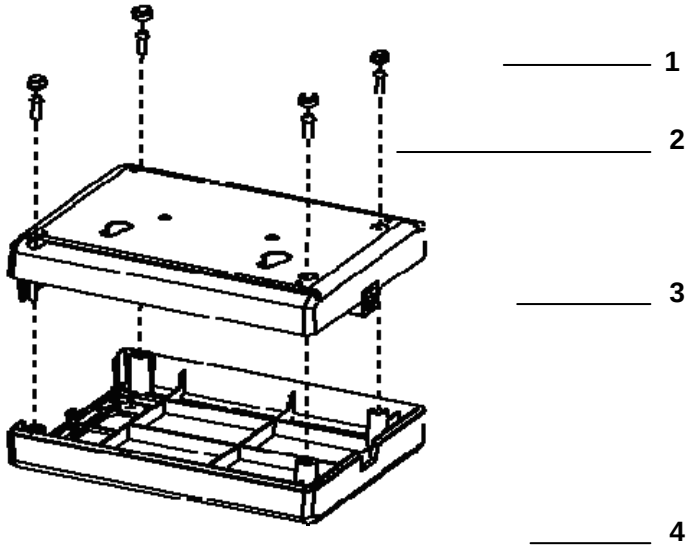


Figure 4-44 Removing Video and Audio Extension Module

No.	Name	Part No.	No.	Name	Part No.
<1>	*Enclosure screw caps*	*PR1E-20-43959*	<2>	*Screw M3X8*	*M04-051177---*
<3>	*Enclosure bottom cover and capture board*	*/*	<4>	*enclosure top cover*	*2108-20-65842-51*

3） Remove three M3X8 screws fixing the video and audio capture card, and remove video and audio capture card.

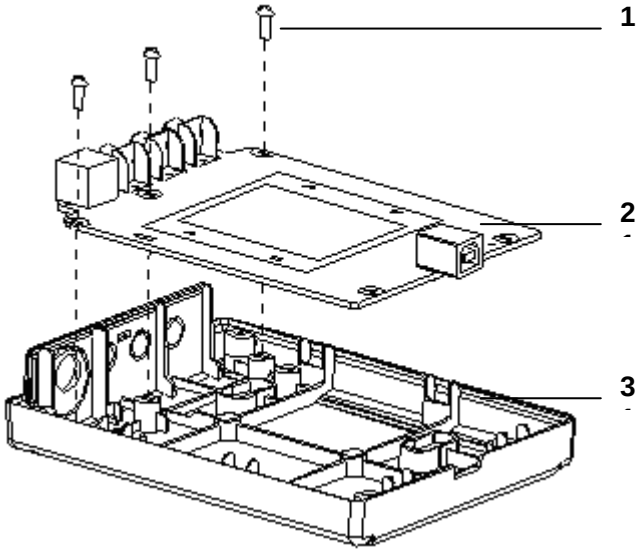


Figure 4-45 Removing Audio and Video Capture Board

No.	Name	Part No.	No.	Name	Part No.
<1>	*Screw M3X8*	*M04-051177---*	<2>	*audio/video capture board*	*2108-30-66219*
<3>	*Enclosure bottom cover*	*2108-20-65843*			

4.3.18 Removing Data Extension Module

1) As shown in Figure 4-46, remove five M3X8 screws, and separate the data extension module.

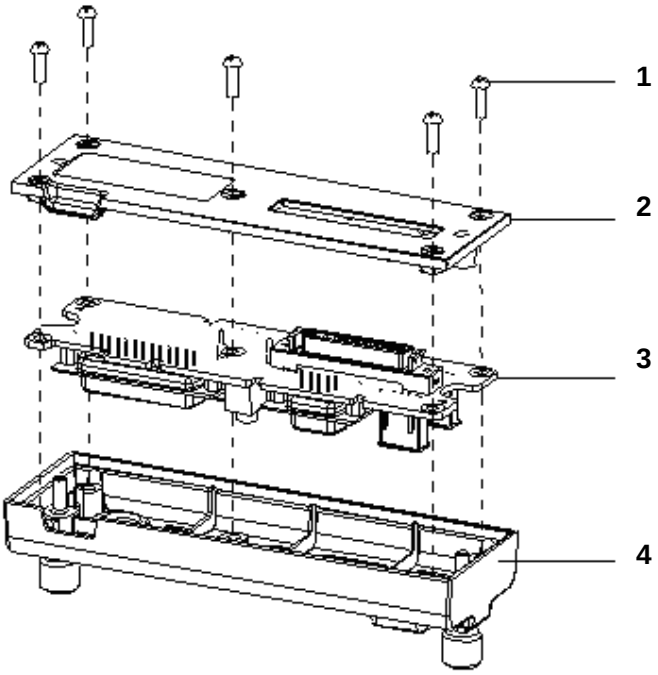


Figure 4-46 Removing Data Extension Module

No.	Name	Part No.	No.	Name	Part No.
<1>	*Screw M3X8*	*M04-051177---*	<2>	*data extension module back cover*	*2108-20-65767-51*
<3>	*IO port extension module*	*2108-30-65871*	<4>	*data extension module front cover*	*2108-20-65766-51*

4.3.19 Disassemble the Dust Net

There are two dust nets (a big one and a small one) for M5. The big one is installed at the left side ventilation opening, and the small one is installed at the right side ventilation opening. Four buckles are used to fix a dust net with the ventilation opening, two at the upper side and two at the lower side. Hold the outline boarder of the dust net, slightly press the outline boarder (effect on the buckle) in the direction as shown in Figure 1; meanwhile, pull out the buckle in the direction as shown in Figure two. After you pull out the other buckle (use the same method as you did on the first buckle), you can take out the dust net. The operation steps are the same for the two dust nets.

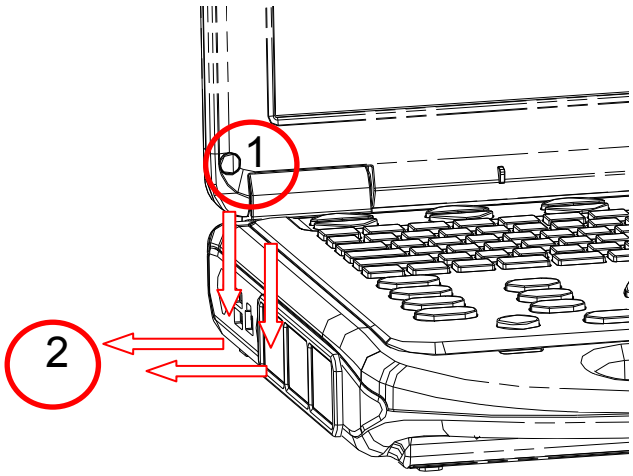


Figure 4-47 Disassemble the Dust Net

5 Function and Performance Checking Method

5.1 Note

The chapter supplies the detailed method for product main function and performance checking. This is used for referring or studying by engineer but not required.

5.2 System Running Status

5.2.1 Running Status

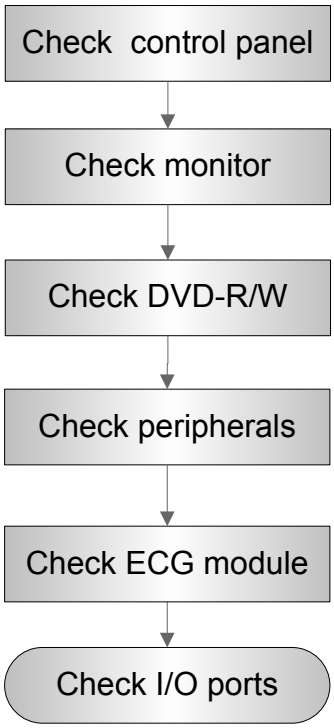
1. Power on/off normal (duration time is normal), no abnormal sounds or phenomena occur during normal operation.
2. After ultrasound system is turned on, the fan starts working and no abnormal sound when the fan is working.
3. Check if configuration, software version are normal through the [About] in preset menu.
4. Check if contrast and brightness of the monitor are normal.
5. Check if time and date are valid and correct.
6. Check if all status indicators are normal.
7. Check all log records with user, to confirm if there is any abnormality.

5.2.2 Working Condition

Check the ambient temperature and humidity. The measurements related to safety features are particularly sensitive to humidity. If the insulation feature of the system deteriorates due to the increase of system service time or system malfunctions, the fluctuation range of measurement results are likely to increase with the increase of humidity.

5.3 General exam

5.3.1 Check Flow



5.3.2 Checking Content

5.3.2.1 Check Control Panel

Procedure	Checking standard
check all buttons, keys and knobs Follow the direction: left to right, and up to down.	All keys and knobs are effective.
Function checking of the trackball: ■ Press the <Freeze> key to enter the Freeze status. ■ Press <Measure> to enter into measure status, do vertical and horizontal measurement, or do other trackball operations.	The trackball can be rotated easily; the cursor responds sensitively, the rotation direction is the same as the direction of the cursor.

5.3.2.2 Check the Monitor

Procedure	Standard
■ Adjust LCD brightness ■ ■ ■ Adjust LCD contrast ■ Enter [Preset]->[Peripheral preset], On the “Input & output” page: ■ ■ ■ Click “9300/6500” ■ ■ Click [default] ■ Monitor maintenance Log on as Service, click [Maintenance]->[Monitor Test] to check the monitor functions	■ Press 『Fn』 and , the brightness increases; and press 『Fn』 and , the brightness decreases. ■ Press 『Fn』 and , the brightness increases; and press 『Fn』 and , the brightness decreases. ■ Color temperature of LCD will be changed correspondingly.”9300” instate cold color temperature. ■ Brightness and contrast load factory values. ■ Click each functional button, the LCD responds correctly, the standard is as follows: 1. Light-spot: 0; flash point: 0. 2. The adjoining dark spots are no more than 3 pairs, and there is no adjoining dark spot in image area. 3. There is no adjoining dark spot of 3 or more than 3. 4. The dark spots are no more than 7 and those in the image area are no more than 2 5. The distance between bad spots is no less than 5mm. Note: image area refers to rectangle when the background is black/right.

5.3.2.3 Check DVD-R/W

Procedure	Standard
■ Press [Eject] ■ Use the optical disk drive to read and burning.	■ Disk can be normally ejected. ■ Normal, no abnormal sounds.

5.3.2.4 Check Peripherals

Procedure	Standard
Footswitch: Connect the footswitch; check the functions of footswitch according to the functions listed in Key Config. （e.g. right key- image frozen, left key- B/W print）	■ Press the freeze key (the right key), image is frozen, the freeze menu is displayed; press the key again, image is unfrozen. ■ Press the print key (left key), B/W printing starts.
Video printer: Check if the video printer and ultrasound system are correctly connected. Then	Press <Print> key, the printer begins to work, no image print deficiency or degradation. Switch video output port; repeat the step.

check the function of each key.	
Text/graph printer: Check if the printer and ultrasound system are correctly connected. Then check the function of each key.	Press <Print> key, the printer begins to work, no print deficiency or degradation.

5.3.2.5 Check ECG Module

Procedure	Standard
Confirm if the ECG module is configured, then: Set [ECG] as “On”.	■ ECG trace is displayed; the heart icon is displayed at the upper right corner of the screen. ■ The parameters [Speed], [ECG Gain] can be adjusted. ■ ECG signal can be reviewed correctly.

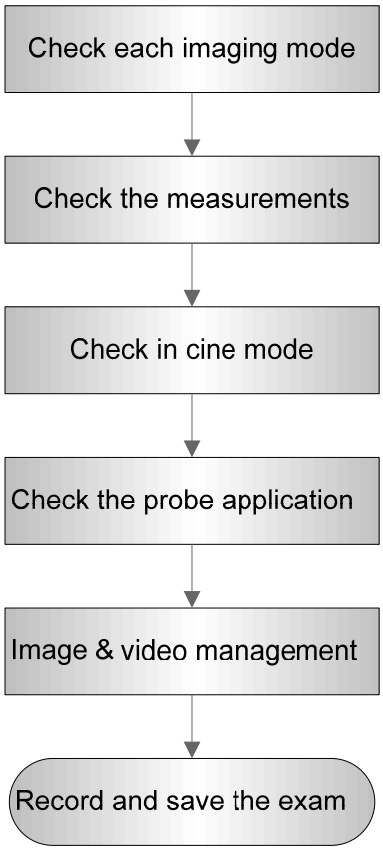
5.3.2.6 Check I/O Ports

Procedure	Standard
Checking the main I/O ports: Besides the video port, USB ports, the other ports required to be checked including: ■ S-video port; ■ Connect external VGA/LCD monitor Network port.	■ ■ The contents displayed on the VGA/LCD are the same as those displayed on the ultrasound system displayer, no character and image loss, no color difference, no fluttering and flicking. ■ Smooth communication.

5.4 Function Checking

NOTE: A complete function inspection is described here, do the checking according to the actual system configuration.

5.4.1 Checking Flow



5.4.2 Content

5.4.2.1 Imaging Modes

1. B mode

- In B Mode scanning, the image parameter area in the upper left corner of the screen will display the real-time parameter values as follows:

Display	F	D	G	FR	IP	DR
Parameter	Frequency	Depth	Gain	Frame Rate	B IP	B Dynamic Range

- Parameters that can be adjusted to optimize the B Mode image are indicated in the following.

Adjustment	Items
Control Panel	Gain, Depth, TGC, iTouch
Menu and Soft Menu	Dynamic Range, Focus Number, FOV Position, Line Density, IP, Colorize, L/R Flip, Rotation, Persistence, Colorize Map, U/D Flip, iTouch, Frequency, Gray Map, Focus Position, iClear, FOV, Smooth, TSI, Curve, Gray Rejection, γ, High FR, iTouch Bright, A. power, B Steer, iBeam, Trapezoid, Image Merge

1. Control Panel

Procedure	Standard
Press <B>	Enter B mode, and B image displays
Gain adjustment. Rotate <iTouch>	Rotate clockwise to increase Rotate anticlockwise to decrease
Depth Adjustment Press <Depth/> direction key.	The image depth will be changed. The adjustable depth values vary depending upon the probe types.
TGC adjustment Adjust through the 8-segment toggles	Push the toggle to the right to increase the corresponding area brightness Push the toggle to the left to decrease the corresponding area brightness About 1.5s after the adjustment is finished, the TGC curve disappears.
iTouch Press <iTouch>	iTouch sign will be displayed in the image area to activate image effect auto optimization.
Image Magnification Press <zoom> to light on the Zoom indicator.	Roll the trackball to change position of the magnified image. Press <Zoom> in zoom status to exit the mode, the current window returns to the display before zoom. Configured with image menu “Magnify” to realize different Magnification.
Press <B>, and then press	● Enter dual mode, and the right image is activated ● Press again to switch between the windows
Press <B>, and then press	● Press 4 times, and 4 images will be displayed on the screen with only one image activated at one time ● Press again to switch among the windows
Press <B>	To enter single mode in multiple window mode, or to exit from other modes.

2. Menu

Procedure	Standard
Frequency B mode menu→ [Frequency]	Frequency value is displayed in real time in the left upper part of the screen via adjusting. The frequency scales of different probes are not the same.
Focus B mode menu→ [Focus Number]/[Focus Position]	Focus number or position can be adjusted. The focus position symbol is displayed on the right side of the image.
Dynamic Range B mode menu->	The dynamic range can be adjusted; the real time value will be displayed on the image parameter area in the upper right of the screen. As the dynamic range increases, the darker the image and the contrast, as well as

[Dynamic Range]	the noise may increase.
Line Density B mode menu-> [Line Density]	Click [Line Density], and rotate the multifunction knob to adjust the parameter. The higher the line density, the higher the resolution, and the lower the frame rate.
iClear B mode menu-> [iClear]	Click [iClear] to adjust, off represents no iClear is turned on, and the bigger the value the stronger the effect. The bigger the value the more clearly the profile of the image.
B mode menu-> [U/D Flip]/[L/R Flip] B mode menu-> [Rotate]	B mode menu-> [U/D Flip]/[L/R Flip] When you flip or rotate an image, the “M” mark will change its position on the screen; the M mark is located in the upper left corner of the imaging area by default.

2. M mode

- In M mode scanning, the image parameter area in the upper left corner of the screen displays the real-time parameter values as follows:

Display	V	IP	DR	G
Parameter	M Speed	M IP	M Dynamic Range	M Gain

- Parameters that can be adjusted to optimize the M mode image are indicated in the following.

Adjustment	Items
Control Panel	Gain, TGC, Depth
Menu and Soft Menu	IP, Time Mark, Speed, Colorize, Colorize Map, Acoustic Power, Edge Enhance, Frequency, Gray Map, Focus Position, Dynamic Range, M Soften, Curve, Gray Rejection, γ, Display Format

3. Color mode

- In Color mode scanning, the image parameter area in the upper left corner of the screen displays the real-time parameter values as follows:

Display	F	G	IP	WF
Parameter	Frequency	Color Gain	Color IP	Color Wall Filter

- Parameters that can be adjusted to optimize the Color mode image are indicated in the following.

Adjustment	Items
Control Panel	Gain, Depth
Menu and Soft Menu	B/C Wide, Frequency, Priority, Baseline, Packet Size, Dual Live, Color IP, Map, A. power, Focus Position, Scale, Flow State, WF, Invert, Line Density, Smooth, Persistence, B Display, Steer

4. Power mode

- In Power mode scanning, the image parameter area in the upper left corner of the screen displays the real-time parameter values as follows:

Display	F	G	IP	WF
Parameter	Frequency	Power Gain	Power IP	Power Wall Filter

Parameters that can be adjusted to optimize the Power mode image are indicated in the following.

Type	Parameter
Control Panel	Gain, TGC, Depth
Menu and Soft Menu	B/C Wide, Frequency, Priority, Dynamic Range, Packet Size, Dual Live, Power IP, Map, Acoustic Power, Focus Position, Scale, Flow State, Wall Filter, Invert, Line Density, Smooth, Persistence, B Display, Steer

5. PW/CW mode

In PW/ CW mode scanning, the image parameter area in the upper left corner of the screen displays the real-time parameter values as follows:

PW	Display	F	G	PRF	WF	D	SV
	Parameters	Frequency	Gain	Pulse Repetition Frequency PRF	WF (Wall Filter)	SV Position	SV Size
CW	Display	F	G	WF	PRF		D
	Parameters	Frequency	Gain	WF (Wall Filter)	Pulse Repetition Frequency PRF		SV Position

Parameters that can be adjusted to optimize the PW/ CW mode image are indicated in the following.

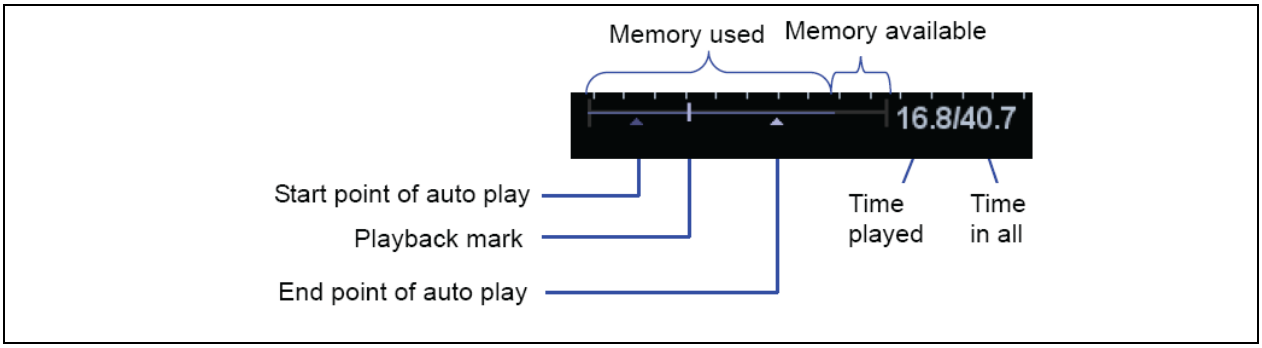
Adjustment		Items
Control Panel		Gain, TGC, Depth
Soft Menu & Menu	PW	Invert, SV, WF, Frequency, Duplex/Triplex, V Max, V Mean, Audio, Trace Area, Colorize Map, Speed, Acoustic Power, Trace Sensitivity, T/F Res, Gray Map, Dynamic Range, Scale, Baseline, Colorize, Quick Angle, Angle, Trace Smooth, Time Mark, HPRF, Curve, Gray Rejection, γ, Display Format, Auto Calculation, Auto Calculation Parameter, PW Steer
	CW	WF, Invert, Colorize Map, Frequency, Speed, V Max, V Mean, Dynamic Range, Audio, Trace Area, Trace Sensitivity, Gray Map, Scale, Baseline, Colorize, Quick Angle, Angle, Acoustic Power, Trace Smooth, Time Mark, T/F Res, Curve, Gray Rejection, γ, Display Format, Auto Calculation, Auto Calculation Parameter

5.4.2.2 Basic Measurements

Procedure	Standard
In B image mode: Press <Measure>	The system enters general measurement mode. Perform any 1-2 measurements (e.g., length, area), the results will display at the right lower part of the image.
Press the same key again or press <Esc>.	Exits measurement.
Do the same operation in other image modes.	Application measurements are classified into different application packages, do the application measurements selectively.

5.4.2.3 Cine Review

Procedure	Standard
Press [Freeze] key to freeze an image, and the [Cine] key indicator lights on. The system automatically enters the manual cine status. (It has been set that when system enters into freeze mode, the default status is cine review.) Press <iStation> key, then click [Review]; or press <Review> key to open a cine file.	The system enters into cine review status The system enters into auto cine review status.
Roll the trackball	Manual cine review
Click [Auto Play] on the menu or soft menu.	Auto play function is turned on, adjust the soft menu button. The greater the value is, the quicker the speed is. When the value is 0, the system exits auto play mode.
Move the cursor onto the desired start point of the cine loop, click [Set First Frame] in the menu or soft menu to set the start point.	Set the start point of cine loop.
Move the cursor onto the desired end point of the cine loop, click [Set Last Frame] in the menu or soft menu to set the start point.	Set the end point of cine loop.
Click [Auto Play] again	Review region is confined to the set start point and end point.
Then press the [Cine] key again.	Cine review stops.
Press the <Freeze> key to unfreeze the image. Press <Cine> or <Esc> key.	Freeze indicator light is off; the system will return to image scanning and exit cine review. The images are still frozen but the system exits cine review.



5.4.2.4 Probe Switching

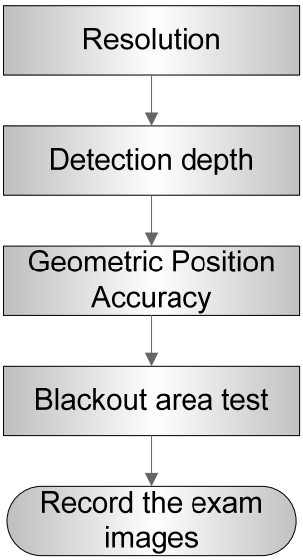
Procedure	Standard
Press <Freeze> key→ connect the probe to the system→ press <Freeze> key→ press <Probe> key to select the probe.	Connect a convex probe to probe socket A, and then connect a linear probe to probe socket B, the operator can select probe A or probe B as the active probe.
Press <Freeze> key→ disconnect the probe→ connect another probe to the port	The system can recognize the newly connected probe in no time.

5.4.2.5 Patient Information Management

Procedure	Standard
Press <Save> (the function already set) during image scanning	Image will be saved to the patient database, and a thumbnail will be displayed at the right part of the screen.
Open [Setup] →[System Preset]→"General", then check "Send/Print Image after End Exam" in the Patient Management area. Press <End Exam> during image scanning	The system automatically sends the images of the exam to the default DICOM storage server or print server.
● Press <Review> key. ● Click [Exit] on the Review screen; or, press <Review> again, or, press <Esc> key	● The system enters into image review mode. ● The system exits image review mode.
● Click [iVision] on the other menu; or press user-defined iVision key. ● Select the contents to be demonstrated, and select the demo mode in the iVision screen. Then select an item already added to the list and click [Start] ● When the demonstration is finished, click [Exit] or press <Esc>.	● Open iVision screen: ● Demonstration begins. ● Image files are played according to file names one by one (including the image of system-relevant and PC-compatible format). ● The system exits the demonstration.
Press <iStation> key to enter patient information management (iStation page)	The saved patient information (images) can be found, and the patient information can be: ● Backed up/ Restored ● Sent (To DICOM.U disk .etc)

5.5 Performance Test

5.5.1 Test Process



5.5.2 Test Content

NOTE:	The image used here is only for reference, stick to the image effect in the real situation.

Requirements:

1. Display: set the contrast and brightness at the clinical application value (or the default status)
2. Operation environment: dark room, simulating the clinical application environment.
3. Scanning techniques: contact the probe with the acoustic window of the phantom, no spacing nor pressing.

Tips:

For the testing phantoms, please refer to Appendix C.

KS107BD is low frequency phantom and used when Probe focus frequency is less than 4MHZ;

KS107BG is high frequency phantom and used when Probe focus frequency is more than 5MHZ;

5.5.2.1 Resolution

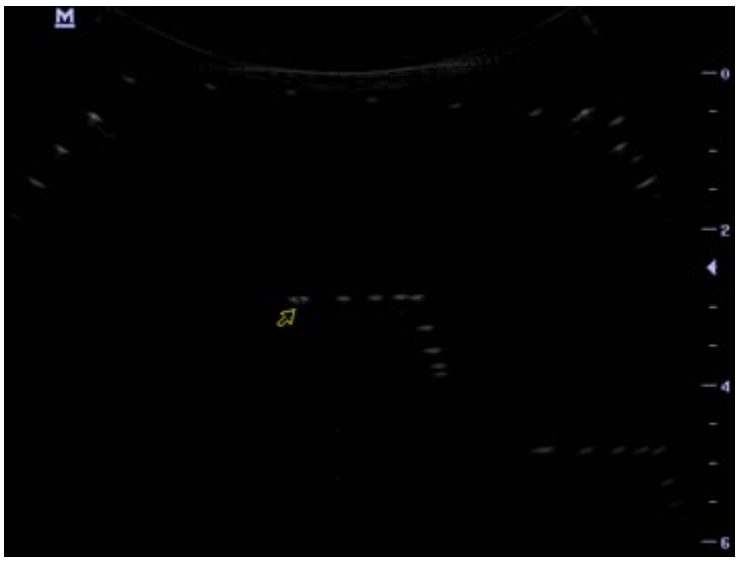
- transverse resolution

Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface, making the transverse resolution testing targets to be displayed around the midline of the image.
2. Adjust the focus point focuses at the position where the transverse resolution testing targets are displayed.

3. Adjust parameters like gain, dynamic range, TGC, making the background tissue unseen, just displaying the target image clearly.
4. In condition that the transverse resolution testing targets are horizontally displayed, record the minimal distance of two targets that can be clearly recognized.
5. Repeat the operation above for the transverse resolution testing targets at other depths.

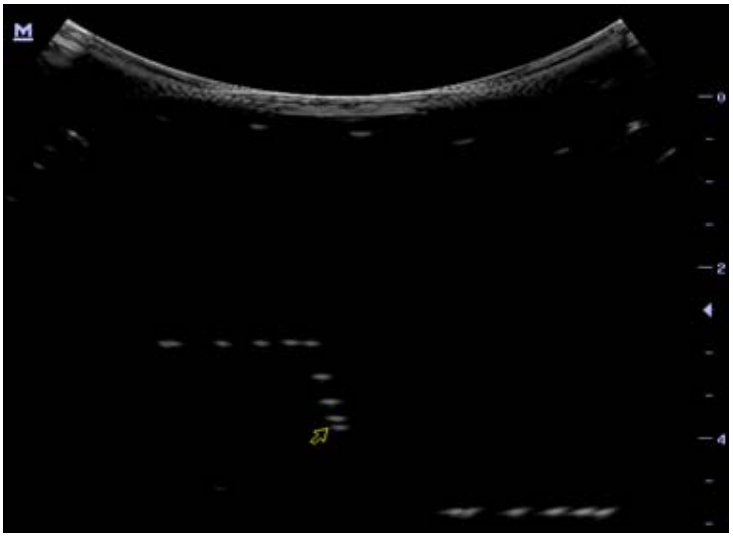
As shown in figure below.



- Axial resolution

Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface, making the longitudinal resolution testing targets to be displayed around the midline of the image.
2. Adjust the focus point focuses at the position where the longitudinal resolution testing targets are displayed.
3. Adjust parameters like gain, dynamic range, TGC, making the background tissue unseen, just displaying the target image clearly.
4. Record the minimal distance of two longitudinal resolution testing targets that can be clearly recognized.
5. Repeat the operation above for the longitudinal resolution testing targets at other depths.



NOTE:	1.	When using the convex probe, keep the transverse resolution testing targets to be displayed near the midline.
	2.	When using a linear probe with steer function, do not turn on the steer function when perform the transverse resolution test.
	3.	Zoom in the region where the targets located if necessary.
	4.	The diameter of the target point at a certain depth is equal to the transverse resolution at the depth.

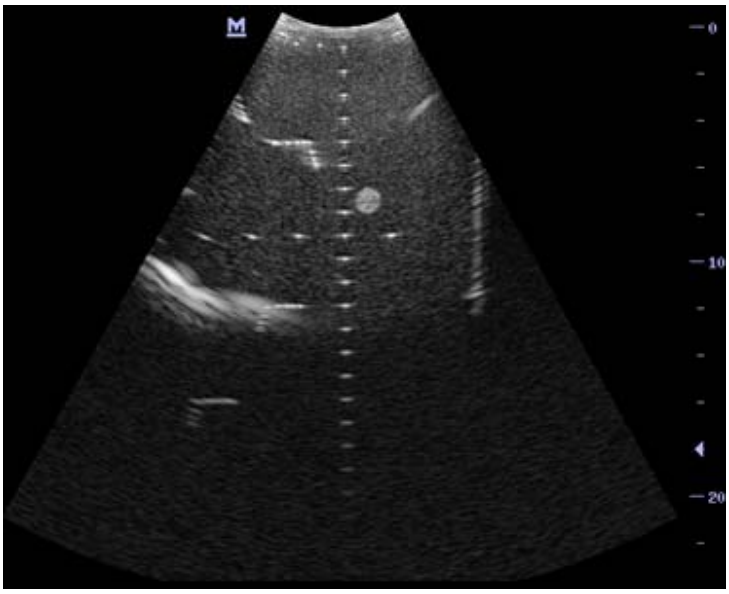
5.5.2.2 Maximum Depth

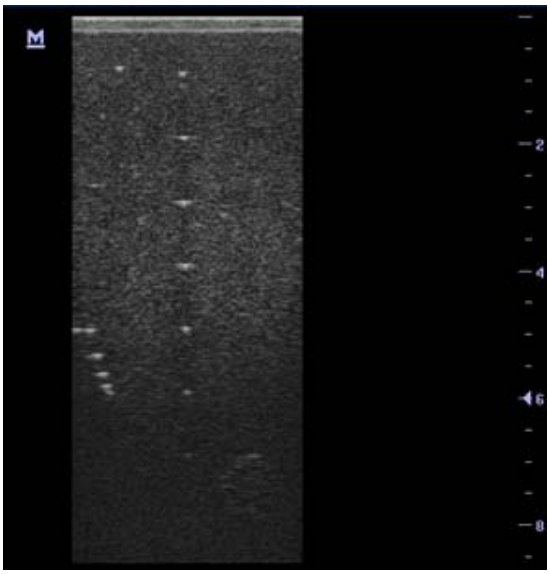
Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface
2. Set the system display depth according to the eXPcted maximum available depth of the probe in use.
3. Adjust the focus point to the deepest, and AP at the maximum value.
4. Set gain, contrast, TGC at a greater value, but no halation nor defocus is allowed.
5. Record the depth of the furthest target (the target can be seen clearly).

NOTE:	1.	Increasing the gain will also increase the noise, and echo may be covered.
	2.	When using a linear probe, please completely contact the probe with the scan surface, no side clearance is allowed.
	3.	When using a convex or phased-array probe, make the axis targets to be displayed at the middle of the scanning image.
	4.	When system is not frozen, the fast field target information may be similar to that of the noise, do not use this target.

As shown in figure below.





5.5.2.3 Geometric positioning accuracy

■ Longitudinal geometric positioning accuracy

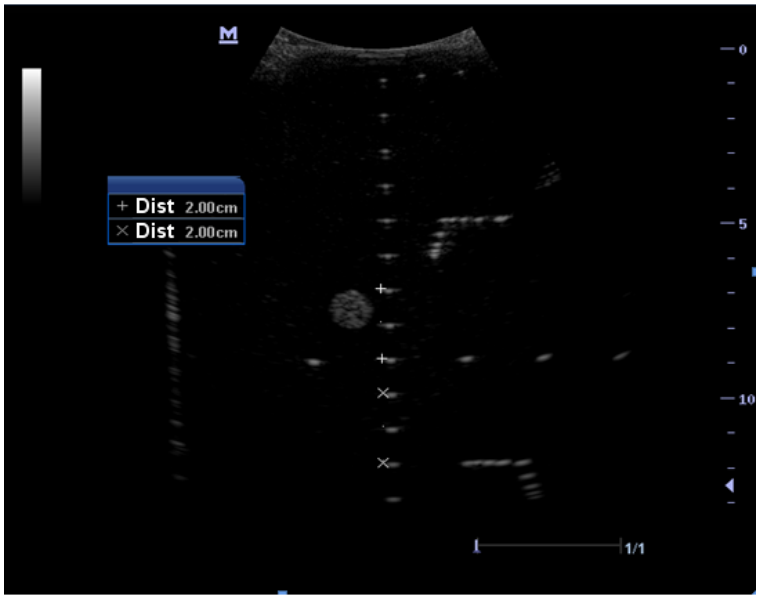
Test Step:

1. Do adjustments as the way in testing the maximum depth.
2. Record the distance by 20mm each segment on the longitudinal targets line using the measurement caliper;
3. Select the value with the greatest error (to 20mm), calculate the accuracy using the formula below

$$\text{Geometric Position Accuracy (\%)} = \left| \frac{\text{Measured value-Actual distance}}{\text{Actual distance}} \right| \times 100$$

NOTE:	1.	The measurement caliper should be positioned at the upper edge of the target, not the middle nor the lower edge.
	2.	The scanning plane should be vertical to the target line, that means the scanning plane is parallel with the cross-section of the phantom

As shown in figure below.



■ Transverse geometric positioning accuracy

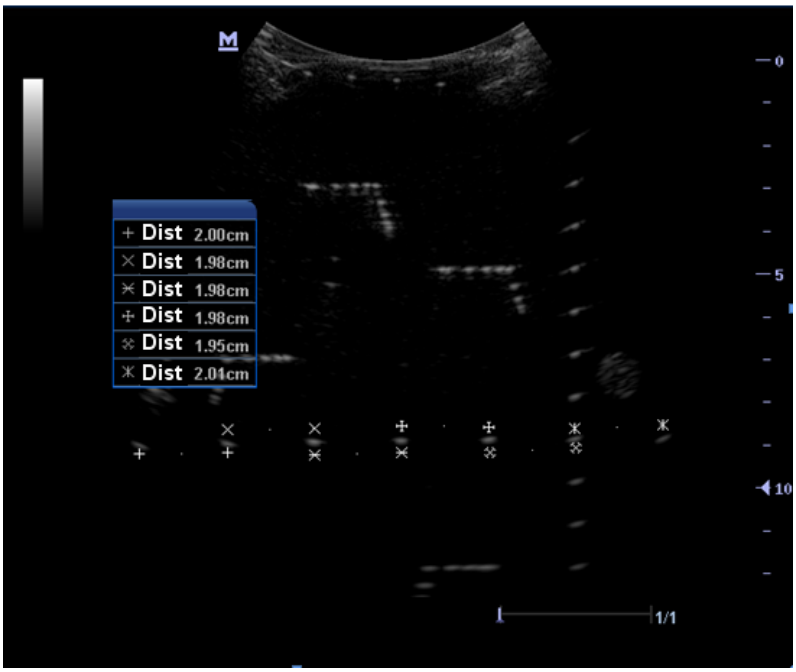
Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface
2. Adjust the depth, making the transverse targets to be displayed in the image.
3. Adjust the focus point to be posited beside the transverse targets (the standard is not clear)
4. Adjust parameters like gain, TGC, making each transverse targets to be clearly displayed.
5. Record the distance by 20mm each segment on the transverse targets line by using the measurement caliper
6. Select the value with the greatest error (to 20mm), calculate the accuracy by using the formula below

$$\text{Geometric Position Accuracy (\%)} = \left| \frac{\text{Measured value-Actual distance}}{\text{Actual distance}} \right| \times 100$$

NOTE:	1.	When using a linear probe, record the transverse distance by segment.
	2.	When using a convex probe, all transverse targets should be displayed integrally in an image.
	3.	The measure caliper should be posited at the upper side or lower side of the target center.

As shown in figure below.



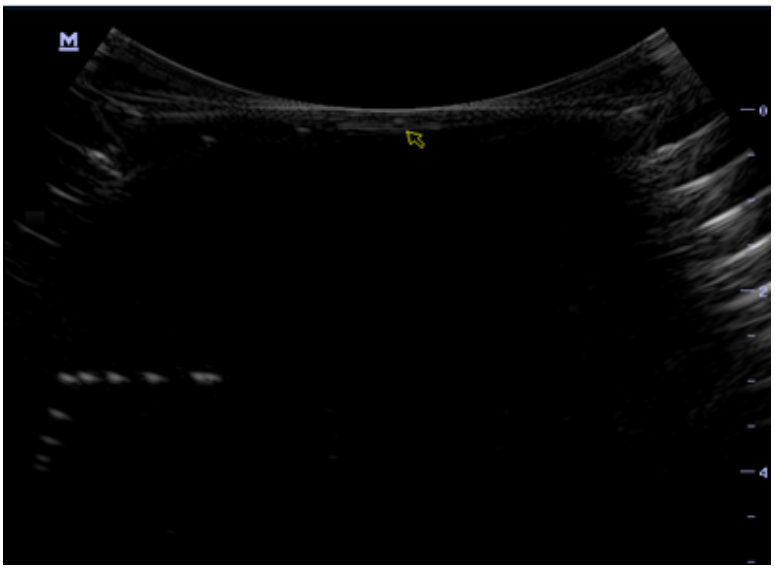
5.5.2.4 Blackout Area

Test Step:

1. Cover the scan surface of the phantom with water or couple gel, gently contact the probe with the scan surface
2. Adjust the depth at a lower value, and set the focus at the nearest place to the scan surface.
3. Decrease the value of parameters like AP, Gain until the background noise just can be seen.
4. Record the smallest depth of the target that can be seen clearly, that value is the blackout area value.

NOTE:	1.	When using a linear probe, please completely contact the probe with the scan surface, no side clearance is allowed.
	2.	For convex probe, the targets in the blackout area should be positioned on the midline of the scanning plane.

As shown in figure below.

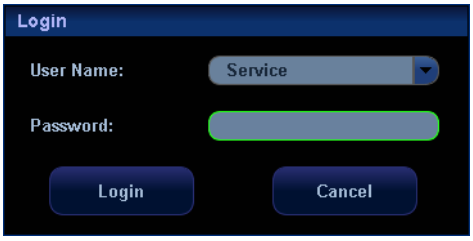


6 System Software

6.1 Software Maintenance

Before performing the software maintenance, ensure the data used matches the model; and enter the maintenance status:

Press the combination key Ctrl+/, and select “service” from the [User Name], input the password and click [Login] to enter the maintenance status.



6.1.1 Entering Preset

Press the [Setup] key, and the Setup menu appears.

6.1.2 Viewing System Information

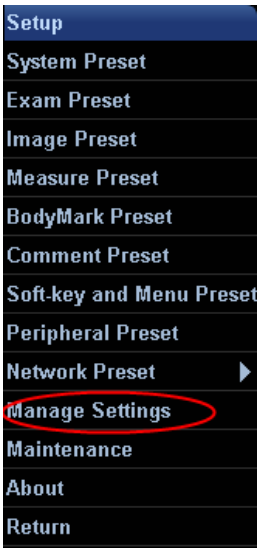
In the Setup menu, select “System”, and the system information dialog box appears. Move the cursor onto “Save” and press [Set], you can export the system information in “txt” format.

Note: Be sure to confirm the system information before and after the software maintenance.

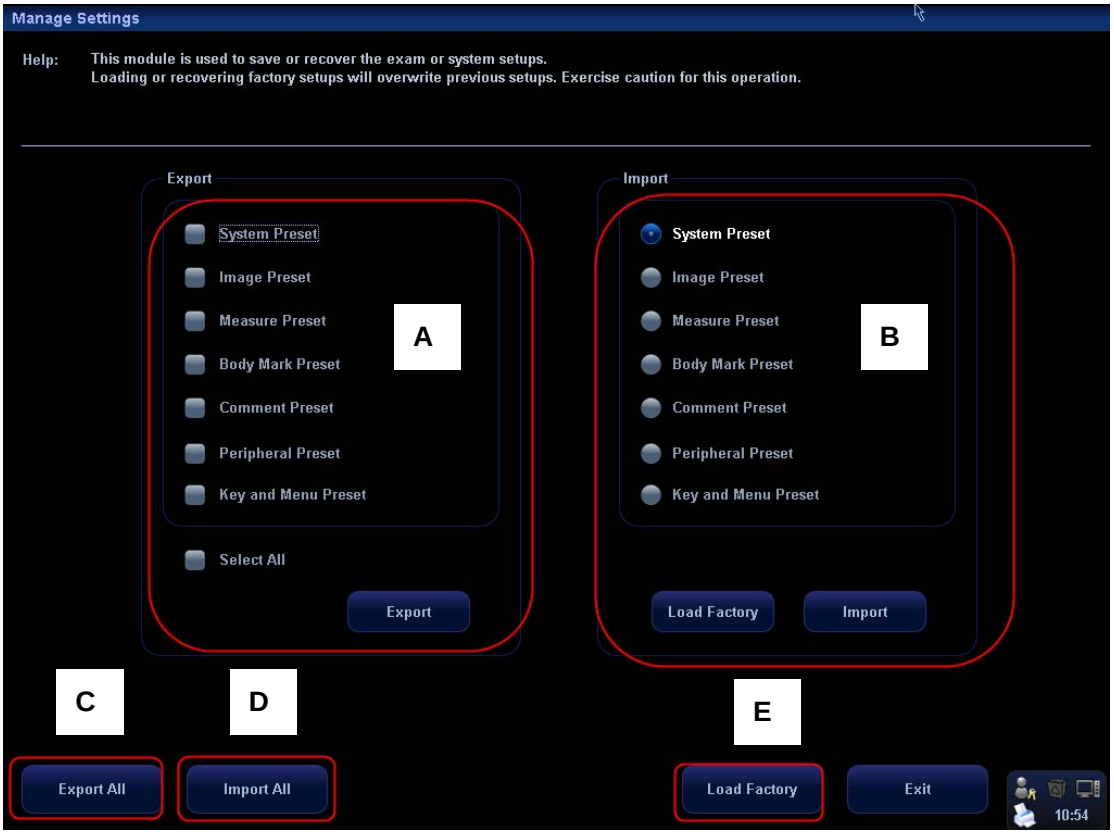
6.1.3 Data Management

1) Press [Setup] to enter the setup status;

2) Move the cursor onto “Manage Settings” and press [Set];



1) Select ”Export” or “Import” as required.



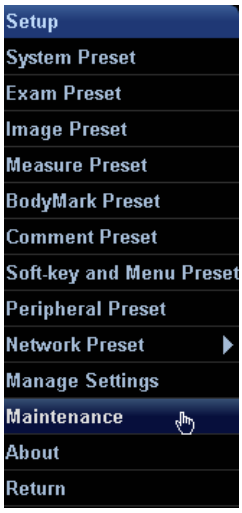
Explanation:

Code in Figure	Function Explanation
A	Export the selected presets, and save them in different files
B	Import the preset parameters, or recover the factory settings
C	Export all preset parameters, and save them in a file
D	Import all preset data at one time
E	Recover factory settings for all preset data

6.1.4 Maintenance Status

Copy the upgrade files to the flash drive, and insert it into a USB port.

1. Enter the Setup status (see6.1.1)
2. Select “Maintenance”



3. Press <Set> to enter the maintenance menu.

6.1.5 Software Upgrade

Note: when upgrading the FP2, the progress bar changes slowly, so you shall be patient and wait.

⚠WARNING: Do not turn off the power when you are upgrading the software.

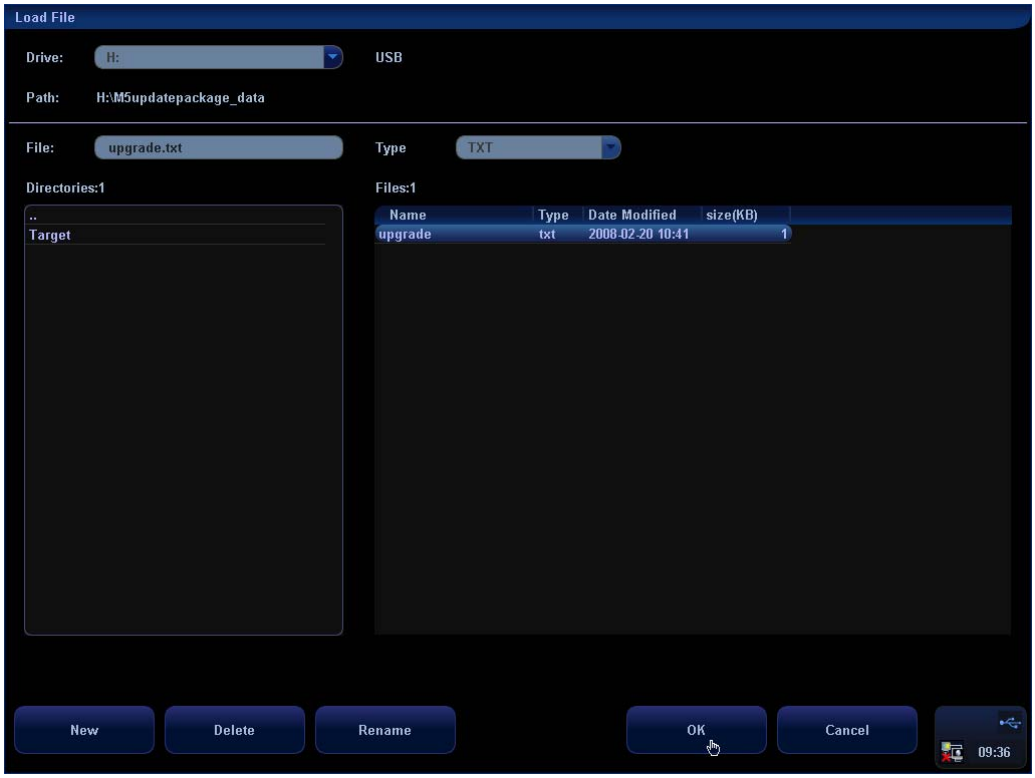
6.1.5.1 Upgrade Package

⚠ WARNING: After using the upgrading package to upgrade the software, you shall upgrade the preset data one item by one item. Otherwise preset error may occur.

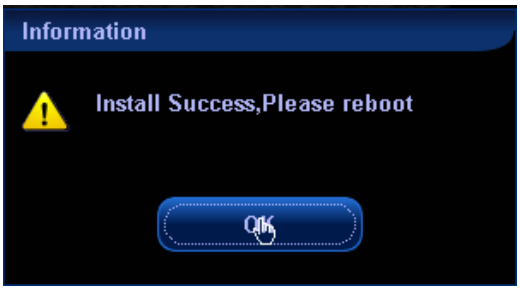
By means of upgrade package, the upgrade contents are the changed contents comparing with the previous version.

1. Enter the maintenance status (see 6.1.4);
2. Select “System Update”, and press [Set];

3. In the file opening dialog box, select correct files, and click OK. The system starts to upgrade, and the progress bar appears at the bottom of the screen.



4. After the upgrading is complete, the successful prompt appears. Restart the system according to prompts.



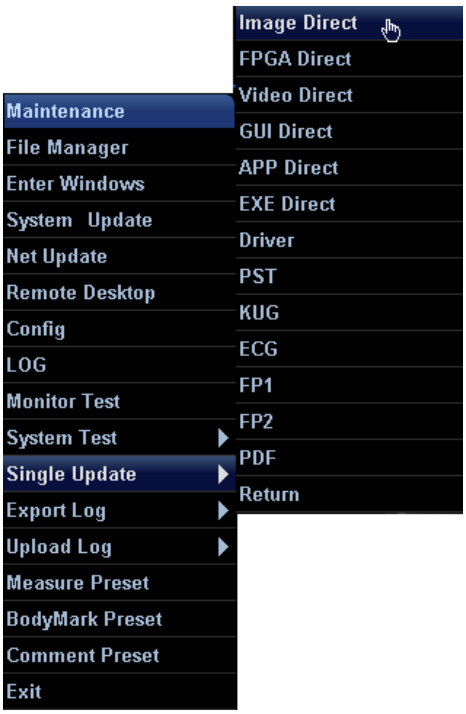
6.1.5.2 Single Item Upgrade

⚠ **WARNING: After upgrading preset data, you shall recover the preset data according to steps described in section 7.2.3, so that the upgraded preset data can take effect.**

Select the preset data according to machine models and Regions where the machine is sold.

Model(Regions where the machine is sold)	M5	M5T	M5Vet
Preset Data File No.	G-110-000836-00	G-2108-30-66188	G-110-000940-00

1. Enter the maintenance status (see 6.1.4)
2. Select [Single update].



3. Select the item to be upgraded and press Set, and in the file opening dialog box select correct files, and click OK, the system starts to upgrade. The progress bar appears at the bottom of the screen;

4. After the upgrading is complete, the successful prompt appears. Restart the system according to prompts.

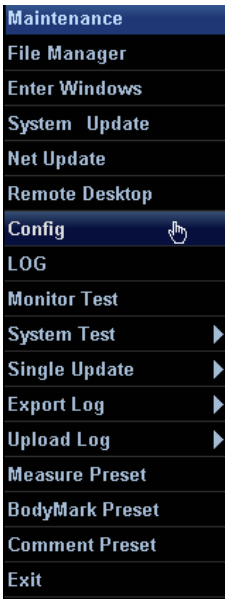
6.1.6 Enter Windows

After doing this, the system enters the Windows interface quickly, and you can install software or drives through the interface.

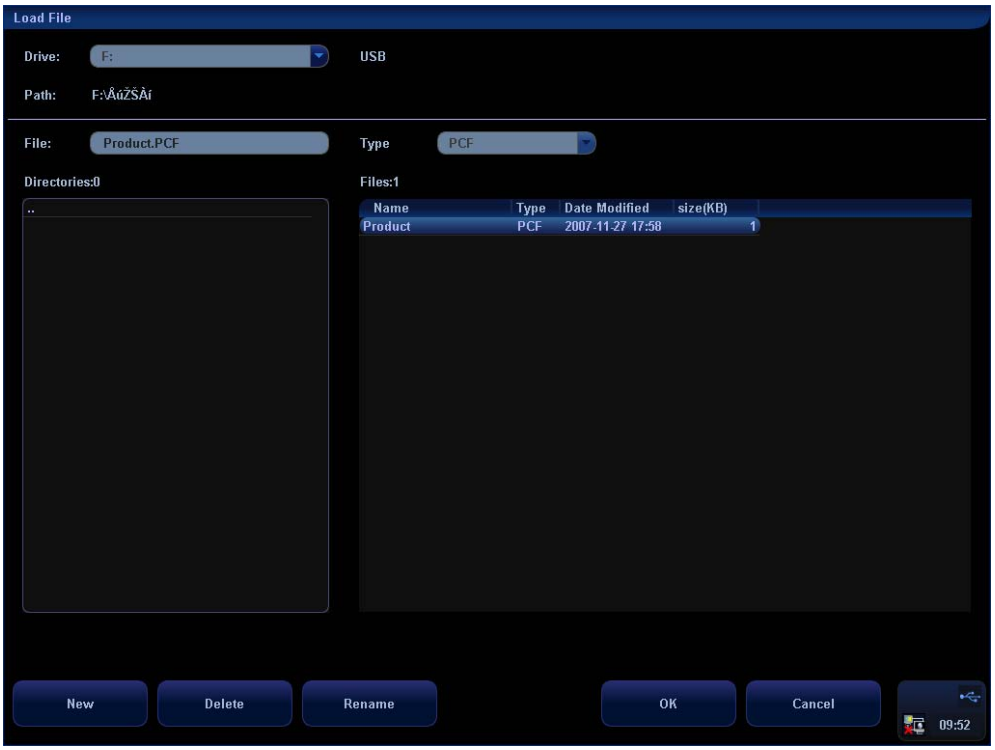
1. Enter the maintenance status (see 6.1.4);
2. Choose the “Enter Windows” menu, and press [Set].
3. It’ll pop up “My computer” window about 2 seconds later.
4. Close the window, then it will retune to ultrasound system interface.

6.1.7 Model Setup

1. Enter the maintenance status (see 6.1.4);
2. Select “Config”, and press Set;



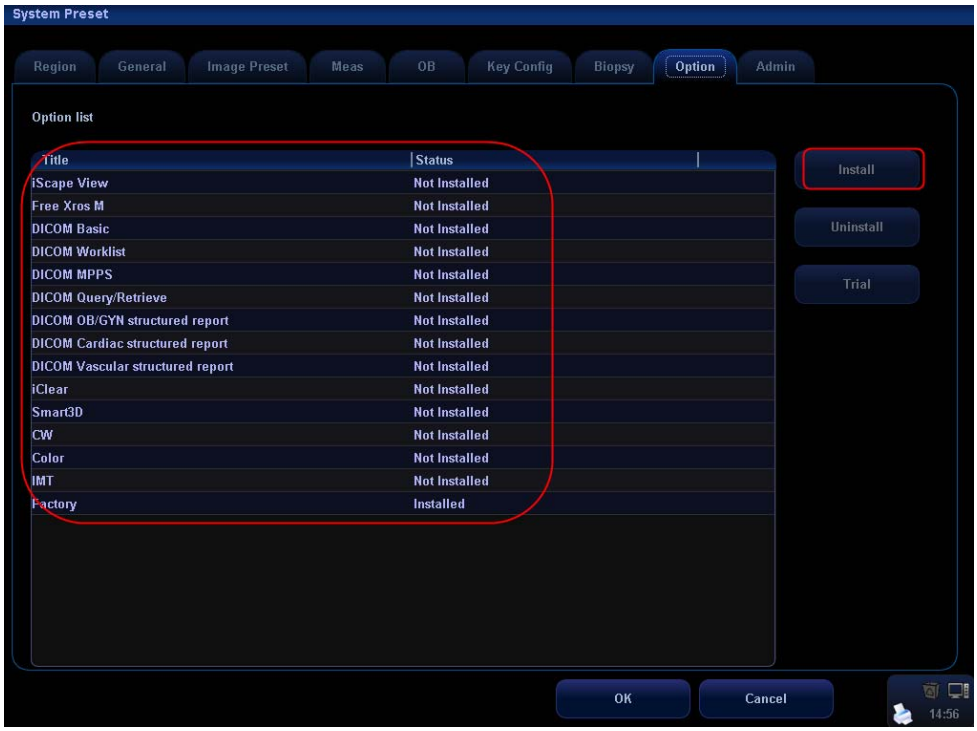
3. The file opening dialog box appears;



4. Select correct files, and click “OK”. After the operation is complete, the successful prompt appears. Restart the system according to prompts.

6.1.8 Installing Optional Software

1. Enter setup status (see 6.1.1);
2. Select “System”;
3. In the system setup dialog box, select “Option”, as shown in the figure below.



4. In the optional list, select the desire software function, and click “Install”;

5. In the file opening dialog box select corresponding key file, and click OK;

The key file is corresponded to the system one by one, and you can copy it to the flash drive, and install through the flash drive;

6. After the installation is complete, return to the system setup screen, and the corresponding options shall be in the installed status. Click OK to close the system setup dialog box.

NOTE: When installing an optional software function, you can find the Key file in the CD provided with the machine.

If you restore ultrasound software, you need to install the optional software function once more.（You must install the Color function and iClear function.）

6.2 System Self-diagnosis

6.2.1 Screen Introduction

The system self-diagnosis screen is divided into four areas.

Figure 6-1 Self-diagnosis Screen

6.2.2 Item Select Area

You can customize your test items in this area, and the test items are grouped into bigger items. If the check box of an item is checked (☑ status), it indicates this item will be placed in the test sequence. Otherwise if the he check box of an item is unchecked (☐status), it indicates this item will not be placed in the test sequence. When you check a bigger item, the small items inside it are checked by default. Otherwise when you uncheck a bigger item, the small items inside it are unchecked by default.

OutDentAll: click this button to unfold all test items;

InDentAll: click this button to fold all test items;

SelectAll: click this button to select all test items;

SelectNone: click this button to cancel all test items selected.

6.2.3 Info Display Area

The area displays test results of test items.

Messages list display test information of each test item:

Index is test number;

Test Name lists test names;

TestResult displays test results;

Remark displays remark information. If the test fails, you can move the horizontal scroll bar to the right side to view the detailed error information. See Figure 6-2

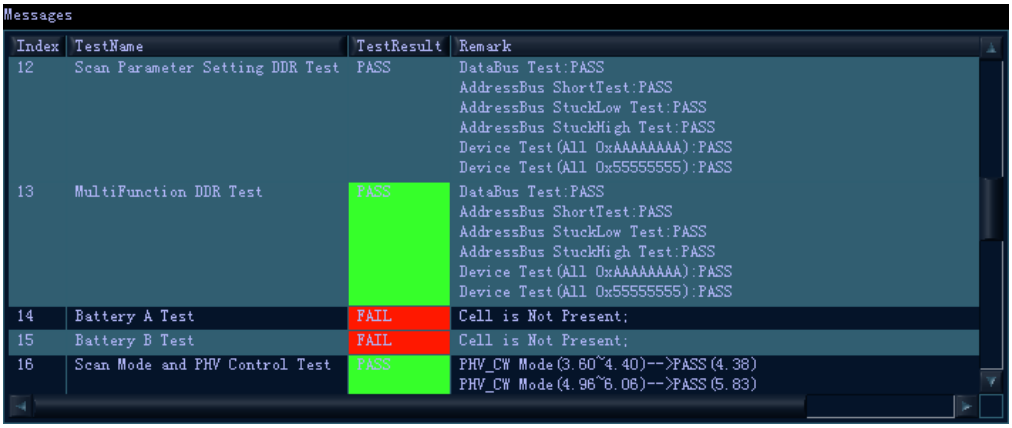


Figure 6-2 Test Result Display Area

On fail pull-down list: there are two options, Continue and Stop. If you select Continue, the test will continue even though a test item fails during testing; however if you select Stop, the test will stop once a test item fails during testing.

Loops check box: check this box to perform loop test. If you check this check box and input a number for loop test at the right side, the loop test will be performed as many as the number you input.

Start button: click this button to perform tests for checked test items one by one, and the button turns to Stop button. During testing, if you click Stop button, the test will stop. After the test is complete, the Stop button turns to Start button, waiting for the next test.

Next Fail button: after the test is complete, it is likely that many test items fail, when you click this button you can view tests failed one by one. After you click this button once, the current failed test item will appear in the first row in Messages list; click this button again, next failed test item will appear in the first row in Messages list.

Clear History button: click this button to clear all test results in Messages list, and recover the flow chart to initial status.

Quit button: click this button to exit self-diagnosis, and return to the Doppler system.

6.2.4 Status Bar

The status bar is used to display information and test progress.

After the program runs successfully, on the left side of the status bar displays the self-diagnosis software version and release date of the system

During testing, on the right side of the status bar a progress bar appears to display the current test progress.

6.2.5 Structure Diagram Area

This area displays the structure diagram of the whole hardware system. During testing, it will colorize and display each module according to test results. If a module is colorized in red, it indicates that communication between the module and the system fails; if a module is colorized in green, it indicates that the module works normally.

6.2.6 Description of Self-diagnosis Test Items

6.2.6.1 Register Read

- **Read of Main Board ID**
  - Test Content

    Read boards and cards Ids of the main board.
  - Test Description

    The boards and cards IDs of the main board are displayed in Remark column of the Messages list box, and the format is:

Main Board Version: x.x

- **Read of DSP Logic Version**
  - Test Content

    Read DSP logic version information of the main board.
  - Test Description

    DSP logic version information is displayed in the Remark column of the Messages list box, and the format is:

The Release Date is YY/MM/DD;

The Compile Version of BF Logic is: xx.

- **Read of MultiFunction Logic Version**
  - Test Content

    Read the multifunction FPGA logic version information of the main board.
  - Test Description

    Multifunction FPGA logic version information will be displayed in the Remark column of the Message list box, and the format is:

The version of MultiFunction FPGA is: xx.

The date of MultiFunction Modified is: YY/MM/DD.

6.2.6.2 Inter Connect Test

1. Connection of BF and DSP (System Control Bus)

- Test Content

  It is test for system control bus connectivity between BF and DSP.
- Test Description

  It is to test the system control bus between BF and DSP on the main board and to verity if it can work normally.

2. Connection of BF and DSP (RF Data Interface)

- Test Content

  It is test for radio frequency data interface connectivity between BF and DSP.
- Test Description

It is to test the radio frequency data interface between BF and DSP on the main board and to verity if it can work normally.

3. Connection of CPU and DSP (PCI)

- Test Content

  It is test for PCI connectivity between CPU module and DSP.

- Test Description

  It is to test the PCI channel between CPU module and DSP and to verity if it can work normally.

4. Connection of CPU and MultiFunction (PCI)

- Test Content

  It is test for PCI connectivity between CPU module and multifunction FPGA.

- Test Description

  It is to test PCI channel between CPU module and multifunction FPGA and verify if it is normal.

6.2.6.3 Memory Test

1. Data Buffer SSRAM0 Test

- Test Content

  It is data buffer SSRAM0 test.

- Test Description

  It is test for SSRAM U36, and has two aspects:

Test if connectivity between FPGA U310 and SSRAM U36 (including data bus, address bus and control signal cable) is normal.

Test if SSRAM U36 device is normal.

2. Data Buffer SSRAM1 Test

- Test Content

  It is data buffer SSRAM1 test.

- Test Description

  It is to test SSRAM U313, and it has two aspects:

Test if connectivity between FPGA U310 and SSRAM U313 (including data bus, address bus and control signal cable) is normal.

Test if SSRAM U313 device is normal.

3. Frame Correlation SSRAM Test

- Test Content

  It is compound frame correlation SSRAM test.

- Test Description

  It is to test SSRAM U314, and it has two aspects:

Test if connectivity of FPGA U310 and SSRAM U314 (including data bus, address bus and control signal cable) is normal.

Test if SSRAM U314 device is normal.

4. Real Time Data Upload DDR1 Test

- Test Content

  It is real-time data upload DDR test.

- Test Description

  It is test for DDRAM U312, and it has two aspects:

Test if connectivity of FPGA U310 and DDRAM U312 (including data bus, address bus and control signal cable) is normal.

Test if DDRAM U312 is normal.

5. Scan Parameter Setting DDR Test

- Test Content

  It is parameter scanning setting DDR test.

- Test Description

  It is test for DDRAM U311, and it has two aspects:

Test if connectivity of FPGA U310 and DDRAM U311 (including data bus, address bus and control signal cable) is normal.

Test if DDRAM U311 is normal.

6. MultiFunction DDR Test

- Test Content

  It is multifunction DDR test.

- Test Description

  It is test for DDRAM U28, and it has two aspects:

Test if connectivity of FPGA U30 and DDRAM U28 (including data bus, address bus and control signal cable) is normal.

Test if DDRAM U28 is normal.

6.2.6.4 Power Circuit Test

1. Battery A Test

- Test Content

  The battery A test is to test if SM bus channel between PC module and battery is normal and the right-hand side battery can work normally.

- Test Description

  If the battery is not in place, the battery communication is not normal or the battery severely fails, this test will fail.

2. Battery B Test

- Test Content

  The battery B test is to test if SM bus channel between PC module and battery is normal and the right-hand side battery can work normally.

- Test Description

  If the battery is not in place, the battery communication is not normal or the battery severely fails, this test will fail.

3. Scan Mode and PHV Control Test

- Test Content

The scanning mode and PHV control test is to test if PHV control is normal in each scanning mode.

- Test Description

  The circuit includes connection circuit between beamformer (U302) and DA chip (U297), U297 chip, connection circuit between U297 DA output and power board and PHV circuit of the power board.

Note: this test will take about 3 minutes, so please wait patiently.

6.2.6.5 System Monitor Test

1. Voltage Monitor Test

- Test Content

  The voltage detection test is to test if power detection circuit of the system main board and power circuit of each group can work normally.

- Test Description

  The test includes connection circuit between PC module and power detection chip U9, U9 chip and voltages of 12V, +5V, 2.5V, 1.5V, -5V and 3.3V on boards and cards are normal.

2. CPU Temperature Monitor Test

- Test Content

  CPU temperature test: to check if the radiating temperature of the CPU is in the normal range.

- Test Description

  The software monitors the CPU temperature for about 10 min by checking value of "Current Temperature" on the testing interface. The system warns for CPU overheat if the temperature exceeds 80 °C. Click "Test Fail" to exit; Otherwise, if the temperature is not more than 80 °C, click "Test Pass" to exit the CPU temperature monitor test. Front End Circuit Test

3. ADC Digital Interface SelfTest

- Test Content

  The front-end ADC digital interface test is to test if digital interface of the front-end circuit ADC chip is normal.

- Test Description

  The circuit includes connection circuit between beamfomer (U302) and front-end AD (U298～U301) and front-end AD chip.

4. ADC DC Bias SelfTest

- Test Content

  The front-end ADC DC offset test is to capture system noise via front-end circuit ADC, and judge if the noise level is normal.

- Test Description

  The circuit includes connection circuit between beamfomer (U302) and front-end AD (U298～U301) and front-end AD chip.

6.2.6.6 Interface Test

1. CW Circuit Interface Test

- Test Content

  It is CW interface circuit test.

- Test Description

  It is to test if connection between CW module and system and CW module are normal.

2. AD Controller Board Communication Test

- Test Content

  It is AD controller board communication test.

- Test Description

  It is to test if SM bus between PC module and AD controller board is normal, and if AD controller board is normal.

3. Transducer Interface Test

- Test Content

  The transducer interface test is to test if transducer ID communication channel between transducer board and transducer is normal.

- Test Description

  For M5-series systems, you need to connect the 7L4S transducer to the transducer socket.

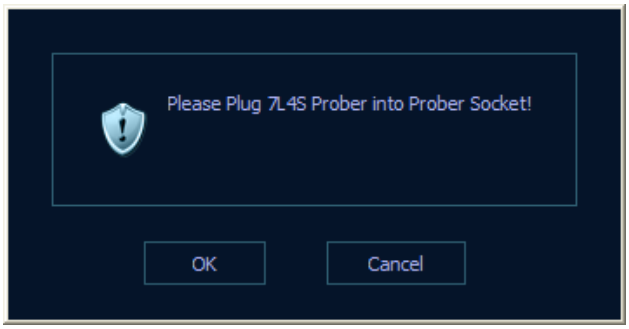


Figure 6-3 Prompt of Connecting 7L4S Transducer

4. Transducer Expansion Module Interface Test

- Test Content

  The transducer extension module interface test is to test if the transducer ID signal channels of transducer board and transducer extension module and transducer are normal.

- Test Description

  You need to connect the transducer extension module and 7L4S transducer to A socket of the extension module before testing. During testing, the program will pop up a dialog box (as shown in Figure 6-4) prompting you to connect the transducer.

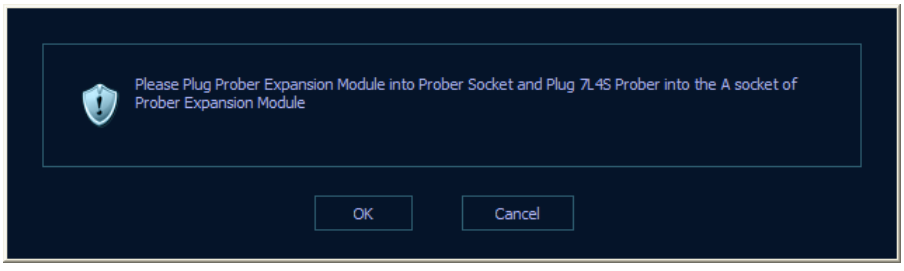


Figure 6-4 Prompt of Connecting Transducer Extension Module and 7L4S Transducer

5. Keyboard Communication Test

- Test Content

  It is keyboard communication test.

  It is to test the keyboard board assembly (key, encoder, trackball, TGC and key backlight), boards and cards ID read, keyboard FPGA version read and keyboard operating program version read.

- Test Description

  Keyboard test screen is shown in Figure 6-5:

Figure 6-5 Keyboard Test Screen

As shown in the figure above, click Start to start the keyboard test. The controls in the simulation keyboard are corresponding to the real keyboard assembly.

For a key, when you press a real key on the keyboard, the corresponding key on the

Simulation keyboard will flicker and turn green. Flickering indicates that the key is under test, and green color indicates this key passes the test.

For the trackball, roll the trackball on the keyboard, the mouse on the screen will move as well, and on the simulation keyboard will flicker and turn green. Flickering indicates that the system has received the data from the trackball, and the green color indicates that the trackball has been tested.

The encoder rotation test: the on the simulation keyboard corresponds to the encoder on the real keyboard. When you rotate the encoder in a direction, the corresponding green ball around encoder on the simulation keyboard will rotate in the same direction. The encoder face will flicker and turn green.

The encoder key test: when you press the encoder key, the encoder key on the simulation keyboard will change status accordingly, and flicker and turn green.

TGC test: 8 TGC sliders on the keyboard correspond to controls on the simulation keyboard. When sliding TGC sliders on the keyboard, the corresponding controls on the simulation keyboard will move as well.

Keyboard backlight test: when the simulation keyboard initializes, all dual-color lights will highlight in green on the keyboard. When a key is being tested, the dual-color backlight will automatically turn orange after it is pressed.

After all tests for the keyboard assembly finish, the keyboard screen is shown in Figure 6-6.

Figure 6-6 Keyboard Test Screen after Tests Finish

After tests finish, if functions of the keyboard assembly are normal, click “Keyboard is OK and Quit” button; otherwise, click “Keyboard is Bad and Quit” button.

6. Serial Port Test

- Test Content

  Serial port test is to test if the serial port of the system can work normally.

- Test Description

  Before testing, you need to connect serial port tester to the serial port.

7. Video Test

- Test Content

  Video circuit and interface test is to test if the video output interface and relevant circuit can work normally.

- Test Description

When testing, you need to connect a video display device (e.g. TV with video input terminal).

During testing, the program will output some display content of LCD display to the video display device, and pop up dialog box as shown below to ask if you can see an image displayed on the display device.

Figure 6-7 Video Test Dialog Box

If you can see it, click “Yes, I can”; otherwise, click “No, I Can’t”.

8. S-Video Test

- Test Content

  S-Video circuit and interface test is to test if S-Video output interface and relevant circuit can work normally.

- Test Description

  When testing, you need to connect video display device (e.g. TV with S-Video input terminal).

During testing, the program will output some display content of LCD display to the S-video display device, and pop up dialog box as shown in the following figure to ask if you can see an image displayed on the display device.

Figure 6-8 S-video Test Dialog Box

If you can see it, click “Yes, I can”; otherwise, click “No, I Can’t”.

9. Audio Test

- Test Content

  The audio circuit test is to test if two buzzers and relevant circuit can work normally.

- Test Description

  During testing, the program will first control the system left side buzzer to give off “ding…”, and pop up the following dialog box to ask if you can hear sound from the left side buzzer. If you don’t hear it, click “Retry” button and replay the sound. If you repeat the play several times without hearing the sound, click “No, I Can’t” button. If you can hear the sound, click “Yes, I Can” button.

Figure 6-9 Audio Test Dialog Box

The program will control the system right side buzzer to give off “ding…”, and popup the dialog box as shown above. The tests for right and left side buzzers are the same.

10. ECG Module Interface Test

- Test Content

  It is to test is connected ECG module can work normally.

- Test Description

  When you connect ECG module with the system and perform self-diagnosis test, the system self-diagnosis will communicate with ECG module, and the system will judge if the ECG module is normal based on ECG feedback information.

7 Care and Maintenance

7.1 Overview

The following procedures are recommended.

7.1.1 Tools, Measurement Devices and Consumables

Table 7-1 Tools and Measurement Devices

Tool/Measurement Devices	Qty.	Remarks
Resin or plastic container	1 pcs	Can accommodate two probes
Soft brush	1 pcs	About a toothbrush size
Small plastic basin	1 pcs	Used to fill the soapy water
Safety test analyzer	1 pcs	Refer to appendix A
Inner hexagon wrench	2 pcs	Inner hexagon wrench 6

Table 7-2 Consumable List

Consumable	Qty.	Remarks
Aluminum foil	About 1 meter	
Physiological saline	About 1000ml	Filling a half container Immerging the whole probe (referring to appendix A). (concentration 0.85 ～ 0.95%)
Mild soapy water	About 400ml	
Dry soft cloth/cotton cloth	About 5 pcs	

7.1.2 Care and Maintenance Items

Table 7-3 Maintenance Items and Frequency

NO.	Maintain content	Frequency	Method
1.	Clean display	Monthly	Referring to 7.2.1
2.	Clean trackball	Monthly	Same as the above
3.	Clean control panel	Monthly	Same as the above
4.	Clean probes (the head)	Every time after using	Same as the above
5.	Clean probe cable and the surface of connector	Monthly	Same as the above
6.	Clean holders (including probe holder and gel holder)	Monthly	Same as the above
7.	Clean cover	Monthly	Same as the above
8.	Clean peripherals	Monthly	Referring to 7.2.2
9.	Check surface of probe	Daily	Referring to 7.3.1
10.	Check power cable and plug	Monthly	Same as the above
11.	Check battery	Annually	Same as the above
12.	Check function of peripherals and options	Annually	Referring to 7.3.3
13.	Mechanical safety inspection	Annually	Referring to 7.3.4
14.	Electrical safety inspection	Annually	Referring to appendix B

7.2 Cleaning

7.2.1 Clean the System

7.2.1.1 Flow of Cleaning

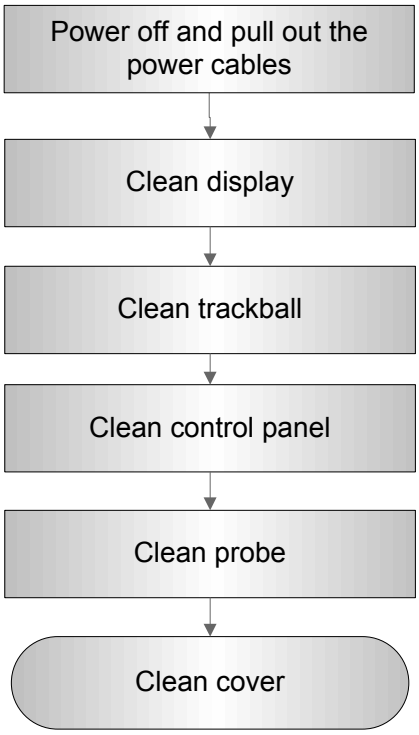


Figure 7-1 **View of Cleaning Maintenance**

⚠**WARNING:**	**Before cleaning the system, be sure to turn off the power and disconnect the power cord from the outlet. If you clean the system while the power is "On", it may result in electric shock.**

7.2.2 Content

1. Clean Display

- Tool: soft dry cloth ,clear water or mild soapy water
- Method:

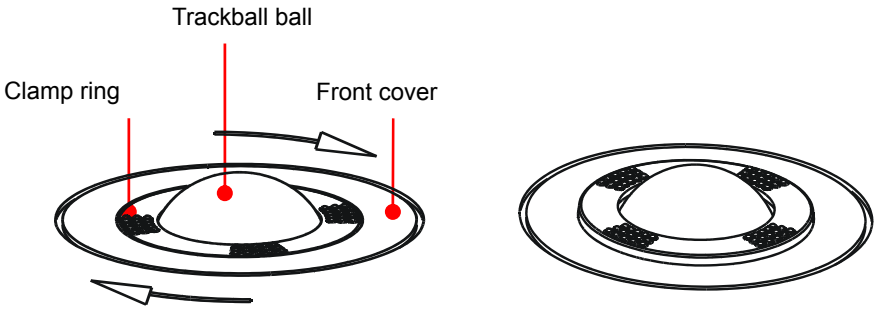
  Surface of display should be cleaned with soft dry cloth. Remained stain should be washed out by cloth with clear water or soapy water, and then air-dry the surface.

2. Clean Trackball

- Paper or dry cloth
- Method:

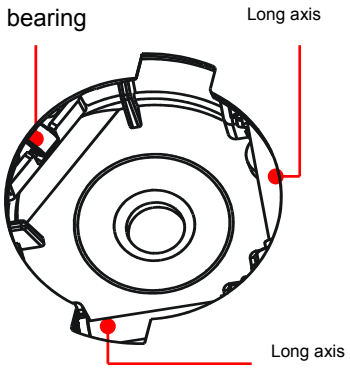
a) Removing the trackball:

Press the protruding points of the clamping ring around the trackball, rotate the clamping ring 45 degrees clockwise. When the clamping ring lifts, remove the clamping ring and trackball (do not let the trackball fall to the ground and make it broken). See the figure below.



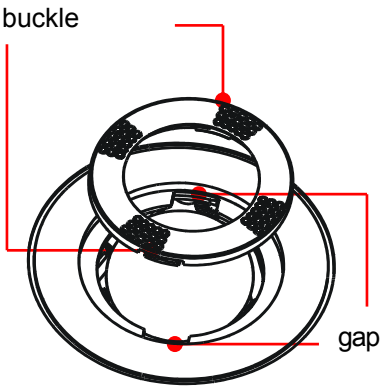
b) Cleaning

Use soft and dry cloth or dry paper to clean the two long axes and bearing of the trackball (see the figure below), and clean the ball.



c) Reassembly

Put back the ball, align the buckle with gap of the front cover, press the clamp ring with both hands and rotate it 45 degrees counterclockwise to click the buckle. At this moment, the clamp ring cannot be moved any further, it indicates that the clamp ring clicks in position. See the figure below.



3. Clean control panel

- Tools: dry soft cloth, mild soapy water
- Method:

  Use dry soft cloth to clean the surface of the system. If the system is dirty, moisten the soft cloth with mild soapy water and wipe off any stains. Use dry soft cloth to remove any moisture and allow all hard surfaces to completely air-dry. If it is difficult to clean the control panel, disassemble the keys first and then use mild soapy water to clean it.

NOTE:	Keyboard on the control panel should be cleaned periodically; otherwise, keys maybe blocked by dirt and buzzer dings, keys don't work.

4. Clean Probe

- Tools: mild soapy water , dry soft cloth , soft brush
- Method:

  a) Wipe out the dust attached to surface of probe, and check if it has any abnormality such as crack;

  b) Remained stain or dust attached to surface of probe cable should be washed out by cloth with clear water or soapy water, and then air-dry the surface of probe cable;

  c) Use a soft brush to clean the probe holder, removing dust simultaneously.

5. Clean Cover

- Tools: dry soft cloth, soapy water
- Method:

  Use dry soft cloth to clean the cover of the system. If the system is dirty, moisten the soft cloth with mild soapy water and wipe off any stains, then air-dry.

  Note: Be sure to use soft brush to brush the dust attached to all the sockets or interfaces which can be seen (such as probe sockets, sockets or interfaces in IO panel and power supply panel),not the cloth with water.

7.2.3 Clean the Peripherals

Do the cleaning maintenance according to your actual peripheral configuration; items which are not configured can be skipped.

Table 7-4 Peripherals Cleaning List

No.	Content	Description
1.	Color and B/W video printer	First wipe off dust or stain attached to the cover of printer with soft dry cloth, then clean the inside of printer. Be sure to do the cleaning maintenance according to the operation manual if is necessary.
2.	Graph / text printer	First wipe off dust or stain attached to the cover of printer with soft dry cloth, then clean the inside of printer. Be sure to do the cleaning maintenance according to the operation manual if is necessary.
3.	Foot switch	Use soft dry cloth with a little mild soap water to wipe off the dust or stain attached to the pedals or cable of foot switch.

7.3 Checking

7.3.1 General check

Table 7-5 General check list

No.	Content	Method
1.	Probe	a) Visually check to confirm that there is no crack and expansion to probe head. b) Visually check to confirm that there is no deterioration or desquamation to probe cable. c) Visually check to confirm that there is no bend, destroyed or falling off pins to the connector.
2.	Power supply adapter	a) Visually check to confirm that there is no wrinkles, crack or deterioration; No crack and expansion to the surface of adapter. b) Manually check to confirm that there is no looseness or rupture. The connection of plug is reliable.
3.	Battery	Check the battery: a) Check the abnormal information or log of battery and ask abnormal situation in use Operate as follow if necessary: b) Check if battery can be charged normally when power-off: Record one capacity value before power-off, then check the capacity change after period of time when power-on. It takes less than 2 minutes to increase 1% capacity when the total capacity is less than 90% and it takes more time when the capacity is more than 90%. c) Disconnect the system from the AC power supply to confirm if the system can maintain normal work status in the battery power supply.

7.3.2 System Function Check

The system function checking is not required during Preventive Maintenance. Engineer or Customer may use it as part of their product Quality Assurance Program tests。

Table 7-6 System function list

No.	Content	Method
1.	B mode	Verify basic operation of B mode. Check basic software and hardware controls affecting B mode operations.
2.	Color mode	Verify basic operation of Color mode. Check basic software and hardware controls affecting Color mode operations.
3.	Doppler mode (PW/CW)	Verify basic operation of Doppler mode. Check basic software and hardware controls affecting Doppler mode operations.
4.	M mode	Verify basic operation of M mode. Check basic software and hardware controls affecting M mode operations.

No.	Content	Method
5.	Measurement（2D, M, Doppler general measurement, applied measurement optional）	Scanning gray scale imaging on phantom, verify distance and area accuracy with measurement control. Verify measurement accuracy by performance test.
6.	Keyboard test	Operate keyboard test to verify if all control keys can work normally.
7.	LCD	Verify LCD display function and parameters adjustment. Refer to that of LCD checking.
8.	Software menu check	Verify software menu display function: if each operation menu and page can be accessed.
Remark：Please refer to 5.4～5.5 for details.		

7.3.3 Peripherals and Options Check

If the system is not configured with any module or peripheral, the corresponding items checking can be skipped.

Table 7-7 Options, Peripherals and Accessories Check list

No.	Content	Method
1.	Color and B/W video printer	Check if the output of video printer is normal.
2.	Graph / text printer	Check if the output of graph / text printer is normal.
3.	Foot switch	Check if the foot switch can implement the set functions according to the program.
4.	DVD-R/W	Check if DVD can work normally (write, read and pop).
5.	DICOM	Check if DICOM can work normally and send pictures and other data to DICOM server.
Remark：Please refer to 5.3 for details.		

7.3.4 Mechanical Safety Inspection

Mechanical safety inspection is mainly used to check mechanical strength and mechanical function of the key assembly of ultrasonic system. The mode of test evaluation mainly is: Perform the evaluation by means of visual check and operating check, if the check result cannot pass, the system is in abnormal status now. Stop using the system and adopt proper measures. The test flow is as following:

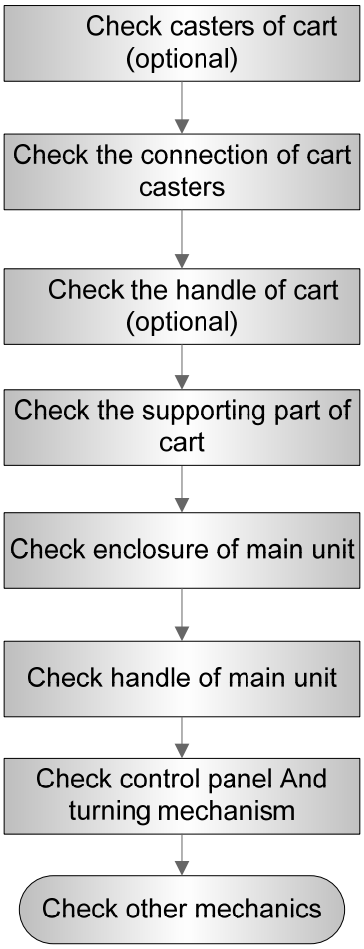


Fig 7-4 Mechanical Safety Inspection Flow

Table 7-8 Mechanical Safety Check

NO.	Item	Method	Tool
1.	Casters of cart	a) Visually check to confirm there is no any crack. b) Operate the casters to confirm the locking and releasing functions are normal.	none
2.	Connection of cart casters	a) Visually check to confirm that there is no skewness and the connecting screws are free of breakage or falling off. b) Check with the spanner to make sure that there is no looseness between the caster and the base connection screw.	Inner hexagon wrench 6
3.	Handle of cart	a) Check by sight if the handle has cracks.	
		b) Use a wrench to check if the handle is loose.	
4.	Cart supporting parts	a) Use hands to check if the supporting parts are loose.	none

NO.	Item	Method	Tool
5.	Enclosure of main unit	Check by sight if there is any crack.	none
6.	Handle	a) Visually check to confirm there is no any crack. b) Rock the handle gently and then lift the ultrasound machine to confirm that the handle is free of looseness and it can accept normal force.	none
7.	Control panel and turning mechanism	Open and close the control panel to see if it is free of looseness or separated from the main unit.	none
8.	Other mechanical structures	{0>确认其他结构件没有零件松脱、外壳开裂，无导电部分外露<}75{>Check to confirm that there is no looseness to other mechanical parts, no crack to cover and no conductive parts show in sight.<0}	none

7.3.5 Electrical Safety Inspection

Only technical professionals or engineers after training can perform electric safety inspection.

Please refer to appendix B: Electrical Safety Inspection for details.

8 Troubleshooting of Regular Malfunctions

8.1 Recover after the operating system is damaged

When the system file or data in the operating system is damaged and the operating system cannot normally start, you need to use the recovery CD to recover the system.

The operating system software：XP installation program (file number：G-2108-30-66108).

The tool used：external USB CD driver.

⚠WARNING: After the system is recovered, the ultrasound software will be deleted. However, the optional software、the model of product and the files in D disk and E disk still remain. After the ultrasound software is reinstalled, you need to perform steps in section 6.1.5.2 to update preset data.

The recovery steps are described as follows:

1. Writing a CD with XPE installation program

Using Nero tool, select “Writer, writing CD mapping file…” in the menu, and then select the desired XPE installation program (2108-30-66108), and write a CD with XPE installation program.

2. Setting up BIOS of the ultrasound system

2.1) connect an external USB CD driver to the USB port of the main unit, and put a CD with XPE installation program into the CD driver.

2.2) start the ultrasound system and press the F2 key on the control panel (you can use the F2 key of an external USB keyboard), and enter the BIOS settings, and enter the BIOS password.

2.3)on the BIOS setting screen, set 【Boot Order】 on the 【Boot】page, and select the USB CDROM as the first to start (use up/down key to select USB CDROM, and press and hold down the “Shift” key, and then press the “+” key; each time you press it, “USB CDROM” will move up once, until this item is moved to the top).

2.4)on the BIOS setting screen, select the【CMOS Restore Condition】as “Never” on the 【Exit】page.

2.5) select “Save Changes”, and press the ENTER key; select “Yes” on the pop-up dialog and press “ENTER” to confirm.

2.6) select “Save CMOS to Flash”, and press the “ENTER” key, and save the settings in the internal flash of the industrial control board.

2.7) finally select 【Exit Saving Changes】to exit.

3. Installing the XP operating system

3.1) after the system is restarted, “Press any key to boot CD …” will appear on the screen; press any key to enter pre-installation environment (PE, Pre-installation Environment).

3.2) after the system is started successfully, the console window will appear and display “Press any key to continue …”; press any key to continue to perform the XPE installation instruction.

3.3) after the installation is complete, the screen will display “Over” indicating the installation is over; after “Press any key to continue …” appears again, press any key to restart the system.

Note: *1. XPE installation will go automatically, so do not interfere the process.*

2. after the XPE installation is complete and the system is restarted, the drive program will be installed, and you may be asked to restart the system again.

4. Recovering the BIOS settings

4.1) after the XPE installation is complete and the system is restarted enter BIOS according to description in 2.2 of section 2. Setting up BIOS of the ultrasound system.

4.2) set 【Boot Order】 on the 【Boot】page, and select the USB CDROM as the first to start (use up/down key to select USB CDROM, and press and hold down the “Shift” key, and then press the “-” key; each time you press it, “USB CDROM” will move down once, until this item is moved to the position below HDD)..

4.3) On the【Exit】page, set 【CMOS Restore Condition】as “Always”.

4.4) Select “Save Changes”, and press the ENTER key; select “Yes” in the pop-up dialog and press the “ENTER” key to confirm.

4.5) Select “Save CMOS to Flash”, and press the ENTER key, and save the settings to the internal flash of the industrial control board.

4.6) Finally select 【Exit Saving Changes】to exit.

After the XP is reinstalled, the ultrasound software also needs to reinstall. The installation method is described in section 8.2.

8.2 Recover after the ultrasound software is damaged

If the ultrasound software is damaged, the failure belongs to either of the following two situations:

1. You can start the ultrasound software and cannot enter ultrasound system operating screen. You have to first recover the system (see section 8.1).

2. You can enter the operating screen of the operating system, but some functions cannot be operated correctly. The following two methods are available:

1) You can perform the upgrading process once more;

2) If the problem is still there, you need to recover the ultrasound software.

The tool used: external USB CD driver.

The software used: M5 recovery package by Customer Service Department (file number：GY-2108-30-66181).

Preparation: using Nero tool, select “data |making data CD…” in the menu, and write the files and file folders in the M5 recovery package (file number：GY-2108-30-66181) to an empty CD. Write an ultrasound system recovery CD.

⚠WARNING: After ultrasound software is reinstalled, you must perform steps in section 6.1.7 Model Setup，6.1.5.2 update preset data and 6.1.8 Installing Optional Software; Otherwise the system may not work normally.（You must install the Color function and iClear function.）

Before reinstalling the ultrasound software, you need to delete the previous ultrasound software and relevant data (including user preset file and backup data in the patient database). You need to delete patient data database in the D disk directory. Before deleting, conduct backup operation.

The method for recovering the ultrasound software is described as follows:

The ultrasound system software shall be installed in the XP screen. If the XPE system is just installed, you can directly use the ultrasound system recovery software to recover the system; if the system still runs in the ultrasound system, you need to exit the ultrasound system, and then enter the XP environment, and finally use the ultrasound system recovery software to recover the system.

A. Recovering the ultrasound system software after the XPE system is just installed

After the ultrasound system recovery CD is put into the CD driver, the installation of the system software will automatically start; when “System need reboot！Please input Enter key to quit the Program!” appear on the screen, press the “ENTER” key on the control panel, and the system will return to the Windows desktop, take out CD, and turn off the main unit, disconnect the USB CD driver from the main unit. Wait about 20 seconds, and turn on the system and enter the ultrasound system.

B. When the system runs in the ultrasound system, recover the ultrasound system software as follows：

1) On the ultrasound screen, press the combined keys “Ctrl+Shift+=” on the control panel, enter the password in the pop-up dialog box, open the on-line debugging device, in the debugging column enter the command “shellapp off”, and click the “Enter” key, turn off the system and start it again. After the system is restarted, it directly enters the Windows desktop.

2) Delete M5 file folder and Patient Bak file folder in the C disk, and delete PADIENTDATA_2108 file folder in the D disk.

3) After the ultrasound system recovery CD is put into CD driver, the system will automatically start installation of the system software. When the screen displays “System need reboot！Please input Enter key to quit the Program!”, press the “ENTER” key on the control panel, the system will return to the Windows desktop. Take out CD, and turn off the main unit, disconnect the USB CD driver from the main unit, wait about 20 seconds, and turn on the system again, it will enter the recovered ultrasound system.

4) After you recover the ultrasound system, you need to configure the system, and install the optional functions according to purchased CD of software functions (refer to 6.1.7 and 6.1.8).

8.3 Recover after the patient database is damaged

When the main database runs it automatically performs backup; when an error occurs, it will automatically use backup database to recover, so it doesn't need to be interfered.

⚠WARNING: If you delete the damaged database, the operation is irreversible, and all patient data stored in the system will lose and cannot be recovered.

If the main database cannot automatically recover, you need to delete the damaged patient database. The deletion method is described as follows:

1. Press "Ctrl+ shift + =" on the ultrasound screen to open the on-line debugging device, input "shellapp off", and press the "Enter" key.

2. Turn off the system and restart it, and enter the Windows desktop.

3. Delete D:\PATIENT_ M5 and C:\PATINET.BAK two directories

4. Run doppler.exe file in the directory of C:\M5\TargetData\exe, and start the ultrasound software.

5. According to step 1, open the on-line debugging device, input "shellapp on", and click "OK" button, and turn off the system and restart it.

NOTE: If the patient database, which is exported to an external medium, is damaged, it cannot be recovered.

8.4 Recovering after HDD fails

If data error occurs in HDD, see sections 8.1, 8.2 and 8.3.

If medium error occurs in HDD, replace HDD, and you can use pre-installed HDD provided by the manufacturer.

If new HDD is used, you need to initialize HDD, and then perform installations of the operating system and ultrasound software according to sections 8.1 and 8.2.

⚠WARNING: If you formalize HDD with data, the data in HDD will be all deleted and cannot be recovered!

The software used：HDD initialization data (file no：G-2108-30-66180).

The tool used：external USB CD driver.

The formalizing method for HDD is described as follows:

1. Writing HDD initialization CD

Using Nero tool, select "Writer, write CD mapping file…" in the menu, and then select desired HDD initialization CD mapping file (2108-30-66180), write an HDD initialize CD;

2. Setting up BIOS, refer to step 2. Setting up BIOS of the ultrasound system in section 8.1.

3. Turn on the power, put HDD initialization CD into the CD driver. After the system is restarted, the screen displays “Press any key to boot CD …”; press any key, and the system automatically enters the pre-installing environment (PE, Pre-installation Environment).

4. After the system starts successfully, the console window appears, and “Press any key to continue …” appears; press any key to continue to perform HDD initialization instruction.

5. HDD initialization process runs automatically, so it needs no interference. After the process is complete, the screen displays “Over” and then displays “Press any key to continue …” after you press any key, the system restarts and the HDD initialization process is completely finished.

6. Install XPE operating system according to section 8.1 and install ultrasound software according to section 8.2.

NOTE: After installation of XPE operating system is complete, you need to recover BIOS settings.

8.5 Inspection flowchart for power adapter and dc-dc circuit

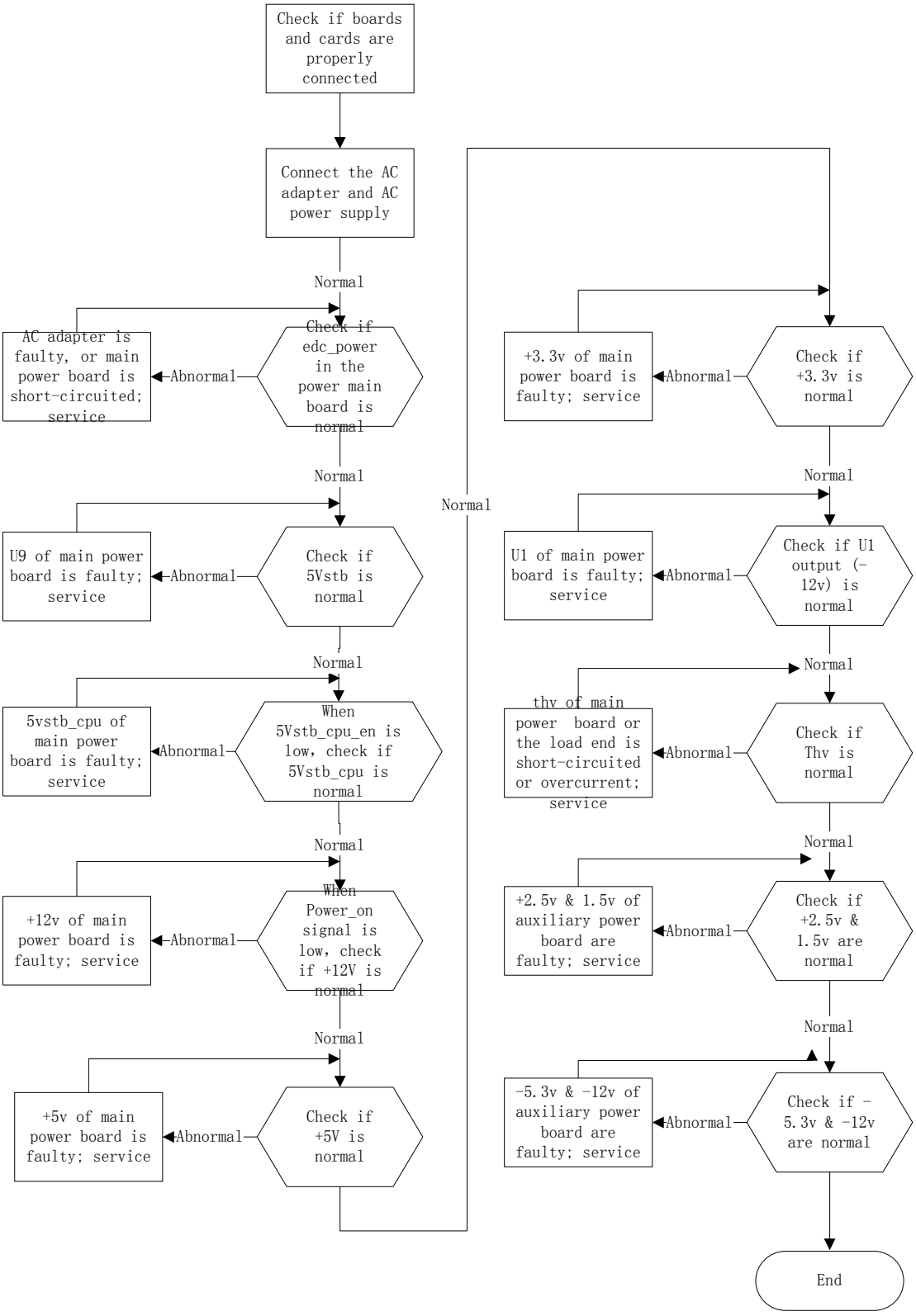


Figure 8-1 Inspection flowchart for power adapter and dc-dc circuit

8.6 Inspection flowchart for battery and charging

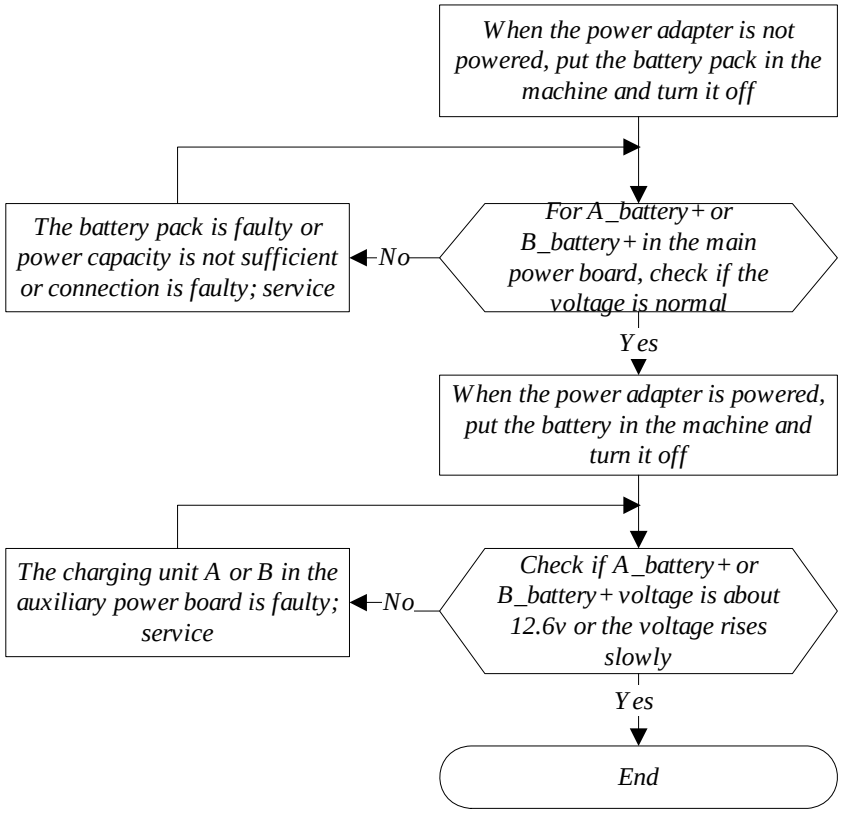


Figure 8-2 Inspection flowchart for battery and charging

8.7 Inspection flowchart for black screen

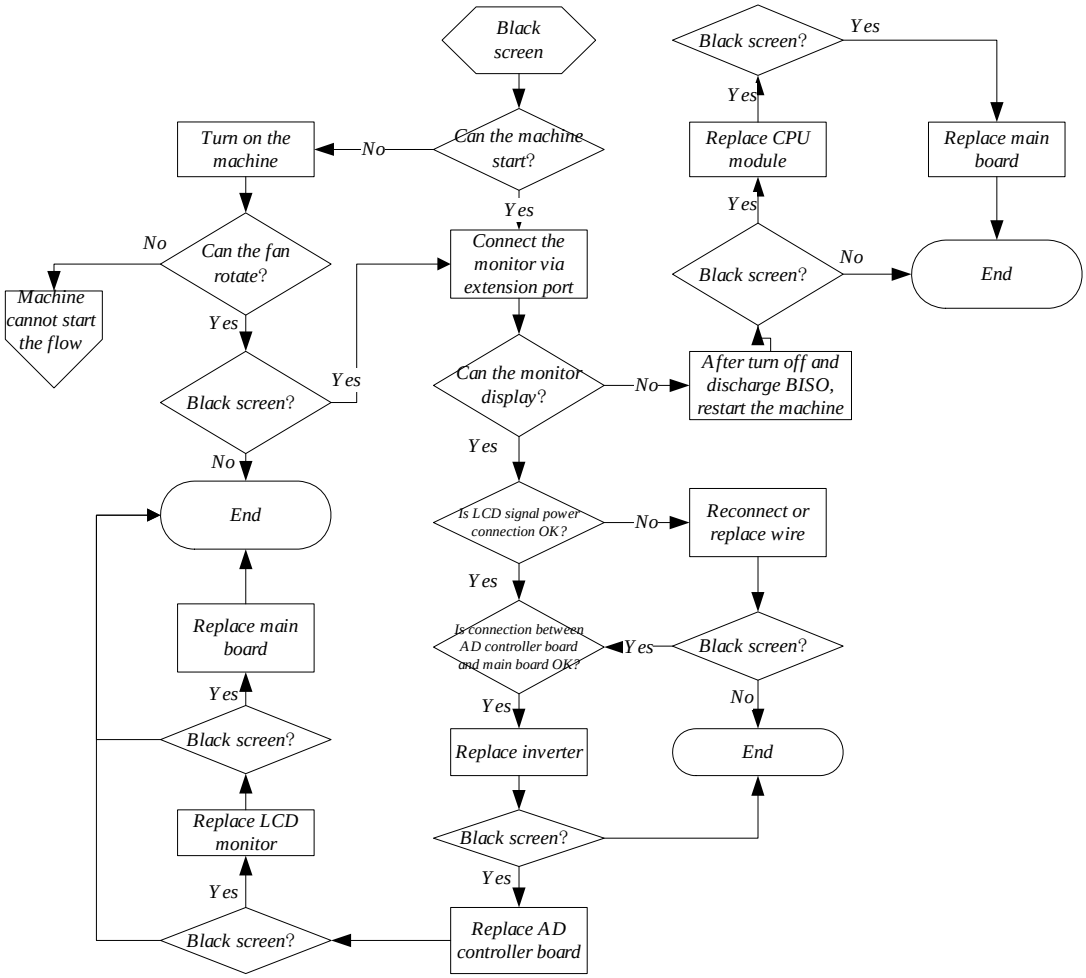


Figure 8-3 Inspection flowchart for black screen

8.8 Inspection flowchart for image area without echo signal

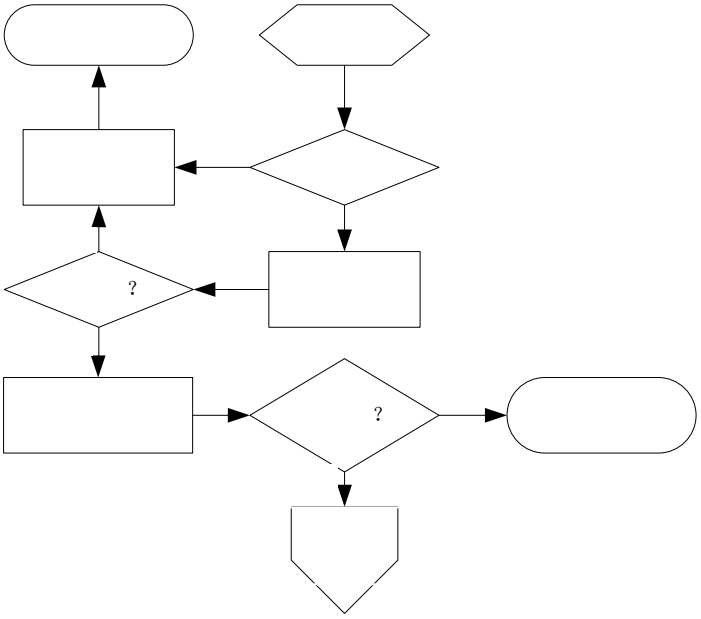


Figure 8-4 Inspection flowchart for image area without echo signal

8.9 Inspection flowchart for image with black area

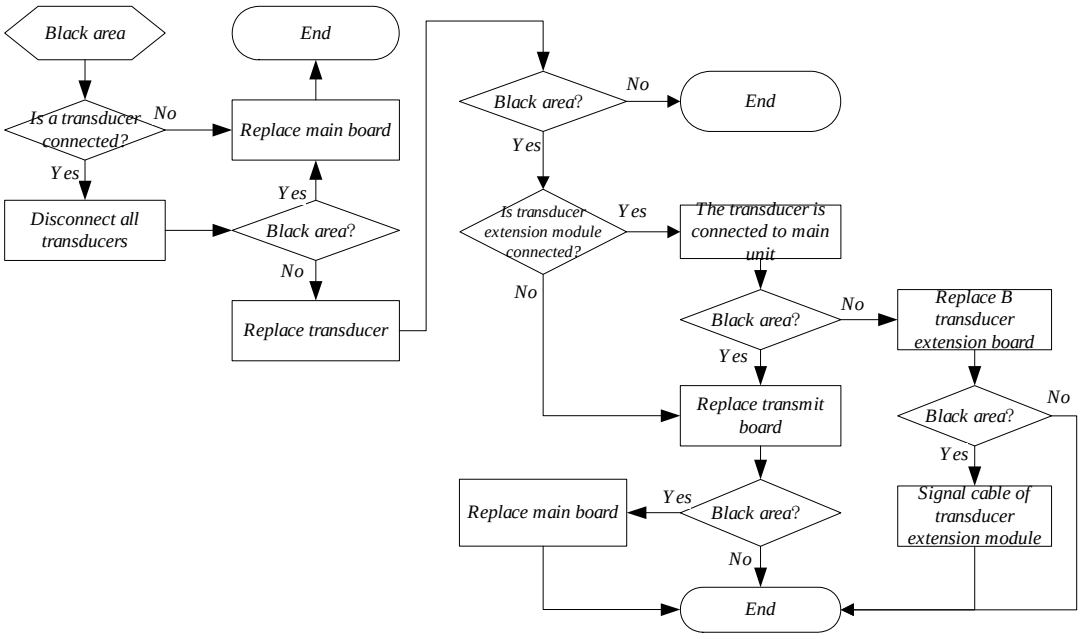


Figure 8-5 Inspection flowchart for image with black area

8.10 Abnormal Image in an Image

Regarding abnormal B, C or PW image, first replace the power board to remove power problem; if it doesn't work, replace the main board.

8.11 Abnormal CW Image

Follow the three steps to resolve this problem:

1. replace to the power board to remove the power board problem;
2. replace the CW board to remove the CW board problem;
3. If the CW board is not faulty, replace the main board.

8.12 Service Flow Cannot Start

The system cannot start the service flow.

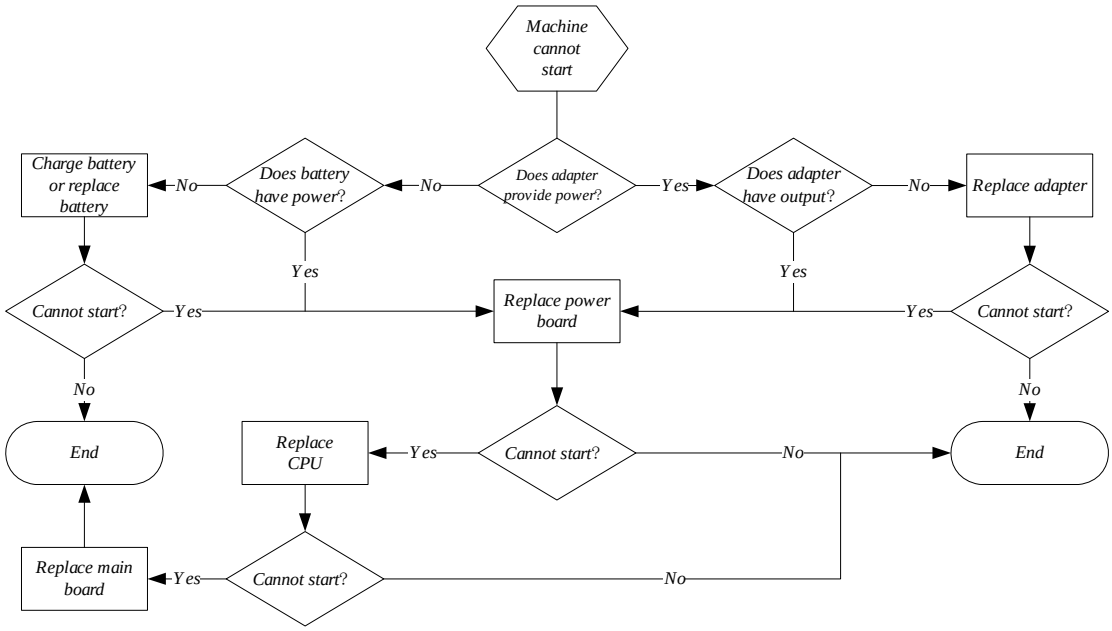


Figure 8-6 Service Flow Cannot Start

8.13 Troubleshooting for PC System

No.	Failure Description	Cause Analysis	Resolution
1	Nothing displayed on the LCD	Connection between the industrial control board and the main board is not secured.	Reinstall the industrial control board, ensuring the connection is secured.

No.	Failure Description	Cause Analysis	Resolution
		The industrial control board does not work	Replace the industrial control board
		The AD controller board does not work.	Replace the AD controller board
2	HDD cannot be recognized	HDD does not work	Replace HDD
		The industrial control board does not work	Replace the industrial control board
3	USB port cannot be used	Confirm if you use a USB device whose bus current exceeds 1A.	Turn off the system and restart it.
4	PC cannot start	The connection between the industrial control board and the main board is not secured	Reinstall the industrial control board, ensuring the connection is secured
		The industrial control board does not work	Replace the industrial control board
5	The system repeatedly restarts after power on.	The power management CPLD software is not correct.	Rewrite the power management CPLD software
		The power management CPLD is damaged.	Replace the power management CPLD
		The industrial control board does not work	Replace the industrial control board

8.14 Troubleshooting for CW board

No.	Failure Description	Cause Analysis	Resolution
1	After power on, the 3.3V or 5V power indicator light doesn't illuminate.	Confirm if the connection with the main board is secured; confirm if power of the main board is sent to the CW board.	Reinstall and ensure the connection is secured. Measure the power pins of J1 and J2 have voltage; otherwise replace the main board.
		Confirm if L41 or L40 works.	Replace damaged inductor.
2	The two amplitudes of CW output signal I and Q are not consistent.	U2, U4 input or output 2.5V voltage is not correct.	Replace U6, U2, or U4
		U1 or U5 is damaged, showing two inputs are consistent but outputs aren't.	Replace U1 or U5
		U13 is damage, showing that its output isn't consistent.	Replace U13
		For amplification and wall filter unit of I and Q, operational amplifier is damaged or peripheral device is damaged.	Measure and contrast point by point, and confirm the damaged device and replace it.
3	CW output signal has high-level harmonic	U13 is damaged	Replace U13

No.	Failure Description	Cause Analysis	Resolution
	waveform	The low-pass filter prior to demodulation is damaged.	Check if filter peripheral device is damaged; confirm the damaged device and replace it.
		The amplification output signal of I and Q is distorted.	Check if amplification peripheral device is damaged; confirm the damaged device and replace it.
		The wall filter output signal of I and Q is distorted.	Check if wall filter peripheral device is damaged; confirm the damaged device and replace it.
4	No CW output signal	The electric switch is damaged.	Replace U11
		The low-pass filter is damaged.	Check if filter operational amplifier is damaged; confirm the damaged device and replace it.
		The demodulation chip U13 is damaged.	Replace U13
		The operational amplifier in amplification and wall filter of I and Q is damaged.	Confirm the damaged device and replace it.
		ADC chip U6 or single end-to-difference circuit is damaged.	Replace U6, U2 or U4

8.15 Troubleshooting for the keyboard board

No.	Failure Description	Cause Analysis	Resolution
1	After power on, neither of LED indicator lights at back of the control panel illuminates.	The main board wire is damaged or connection is not secured.	Replace the main board wire and reinstall it.
		The fuse F4 or F3 is open circuit.	Replace the fuse
		F4, F3 or system ground is short-circuited.	Check if there is short-circuit of soldering.
2	LED D175 and D176 illuminate, but D177 doesn't.	The fuse F2 is damaged.	Replace F2
3	LED D175, D176 and D177 illuminate, but FPGA configuration light D1 doesn't illuminate.	FPGA configuration files aren't written.	Write FPGA configuration files.
		Check if FPGA core voltage is normal, and test the voltage drops of two ends of C101, whose standard value is 1.2V.	Replace U20
4	After the FPGA is written, the configuration light D1 doesn't illuminate or flickers and the keyboard board	Check if FPGA core voltage is normal, and test the voltage drops of two ends of C101, whose standard value is 1.2V.	Replace U20

	program cannot run normally.	FLASH is damaged.	Replace U3
5	TGC value is unstable; even when you don't move the slider, the value varies; the offset between the value and position is great.	Check if TGC connection wire (J2) is secured.	Ensure the connection is secured.
		The connector of TGC connection wire looses.	Replace TGC connection wire.
6	Some LED lights don't illuminate in boards and cards, and the dual-color light always lights on or off at the same time.	Check if the LED soldering direction is correct; check if the lights are damaged at appearance; check if the pin of dual-color light is open circuit.	Solder or replace the component.
7	Windows cannot recognize the keyboard board (the power of boards and cards is normal, and software and logic are correctly written.)	Windows is not installed with the keyboard board drive	Install the drive
		The main board connection wire is damaged.	Replace the main board connection wire.
		Test if USB common-mode inductor L8 is normally conductive.	Replace L8
		The anti-static chip U5 is damaged.	Replace U5
		The USB interface chip U4 is damaged.	Replace U4

8.16 Troubleshooting for ECG board

No.	Failure Description	Cause Analysis	Resolution
1	After the ECG module is connected, the system prompts a USB device connected.	Check if USB connection wire can normally work.	Replace USB connection wire
		Open the ECG power board to check if the power light D15 illuminates; if not, the power fails.	Refer to power failure resolution (Note A)
		Check if USB communication indicator (D17) illuminates; if not, the USB chip cannot normally complete "device enumeration", indicating the USB communication fails.	Refer to USB communication failure resolution (Note B)
2	After the ECG module is connected, the system detects unknown USB device, not recognizable.	The CP210X chip drive is not installed.	Install the drive.
		Check if USB communication indicator (D17) illuminates; if not, the USB chip cannot normally complete "device enumeration", indicating the USB communication fails.	Refer to USB communication failure resolution (Note B)

3	After the ECG module is connected, the ultrasound system software cannot recognize the ECG module, but the Windows operating system can recognize the USB communication chip of the ECG board.	The product ID is not correctly written. The product ID inquiry method is as follows: click the right button on “My Computer”, open “Attribute” dialog box, open “Device Manager” on the “Hardware” page. Open “Ports (COM & LPT)” pull-down menu; if windows can correctly recognize the chip, you can see “CP210X USB to UART…”. Click the right button on the device to open the attribute dialog box, you can see its ID. See Figure 8-7 below.	Rewrite the product ID.

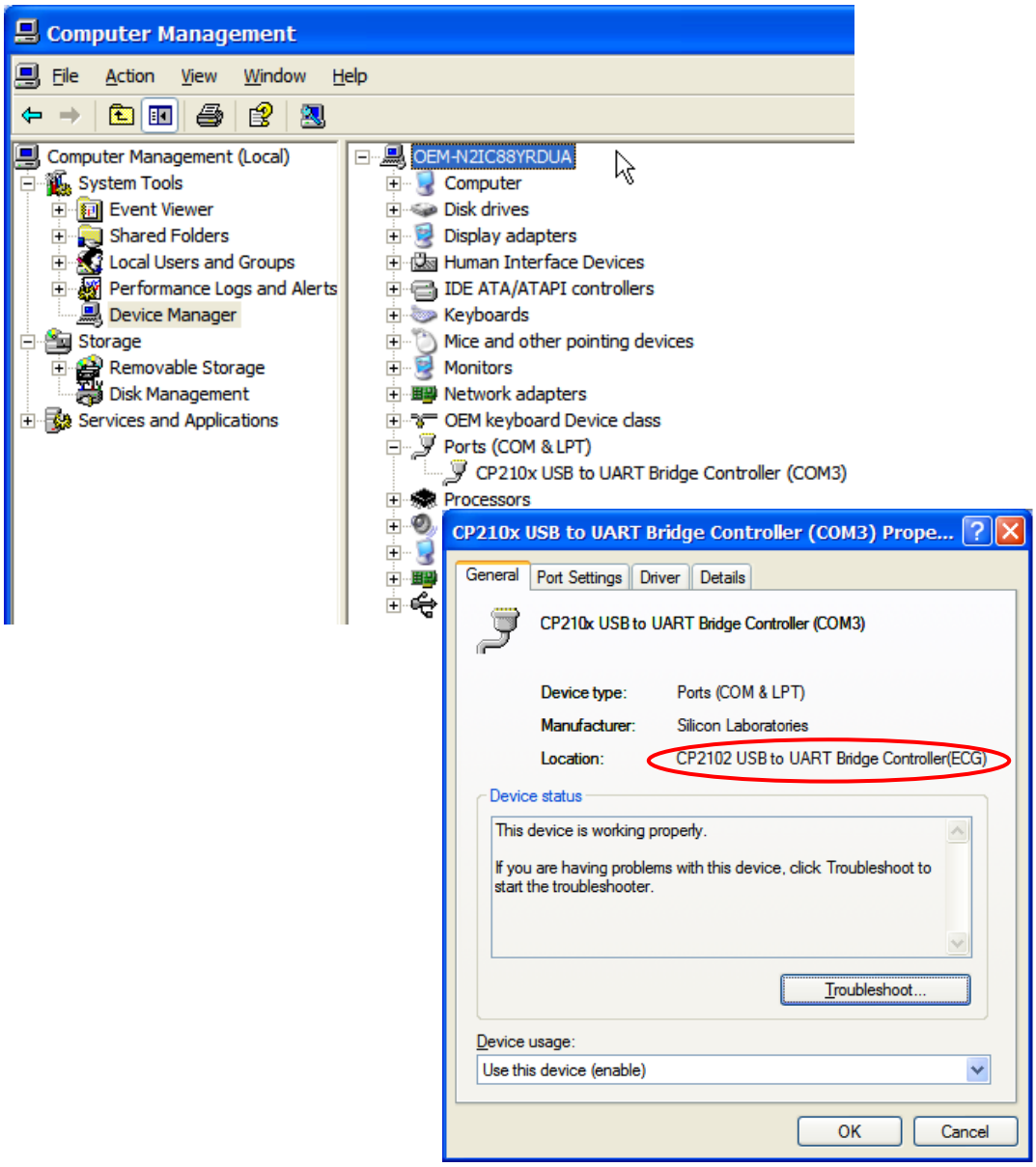


Figure 8-7 Product ID of USB Device

Note:

A．ECG board power failure resolution

When you resolve the power failure, you shall check level by level. See Figure 3-29 functional block diagram of ECG board power, it indicates device names of key units in the power circuit. The following table lists information of testing points (refer to 6.2.6.6 for the corresponding numbers).

Table8-1　information of power testing points

No.	Standard voltage (V)	Voltage testing points	Failure analysis	Failure resolution
1	5±10％	voltage drops of two ends of C46	USB cable is damaged.	replace USB cable
2	5±10％	voltage drops of two ends of C102	Test if inductor L6 is conductive; if not, replace L6. if yes, U26 may be damaged.	replace L6 or U26
3	12±10％	voltage drops of two ends of C109	U17 is damaged.	replace U17
4	3.3±10％	voltage drops of two ends of C90	U23 is damaged.	Replace U23
5	6±10％	voltage drops of two ends of C86	Test if T1 primary or secondary coil is open circuit. If it is open circuit, replace TI. Otherwise Q1 or U18 may be damaged.	Replace T1 or Q1 or U18.
6	-6±10％	voltage drops of two ends of C87		
7	5±5％	voltage drops of two ends of C92	U22 is damaged.	replace U22
8	3.3±5％	voltage drops of two ends of C95	U24 is damaged.	replace U24
9	3.3±5％	voltage drops of two ends of C73	U19 is damaged.	replace U19
10	-5±5％	voltage drops of two ends of C93	U25 is damaged.	replace U25

B．USB communication failure resolution

1. Test if the inductor L5 conductive resistance is less than 1ohm; if not conductive or the conductive resistance is greater, replace the inductor.
2. Replace anti-static chip U8.
3. If the above-mentioned two chips are normal, CP2102 (U15) may be damaged, and needs to replace.

8.17 Troubleshooting for video & audio capture card

No.	Failure Description	Cause Analysis	Resolution
1	After the video capture card is connected, the screen prompts that the surge occurs or enough current cannot be provided.	USB interface cannot provide sufficient power to drive the video capture card.	replace the main board

2	After the video capture card is connected, the screen doesn't display images.	USB wire connection is not secured.	Disconnect it and connect it once more.
		The chip is damaged.	replace the chip
3	The image is not continuous or some image frames are missing or discolored	The signal cable is bad contact, e.g. SVIDEO signal cable is bad contact or USB signal cable is bad contact.	Change cable or change interface socket.
4	After the video capture card is connected, clicking the capture command cannot normally capture sound.	The installation of the drive isn't correct.	Reinstall the drive.
		Check if the audio input signal rule is specified in the capture software	Specify it in the software.
		Check if there is BCLK signal, if not, it indicates EMP202 chip is damaged.	replace the chip
6	Only part of the source video can be seen.	The video displayed by capture card is of 640*480 resolution. If resolution is not correct, the display will be abnormal.	/

8.18 Troubleshooting for transducer extension module

No.	Failure Description	Cause Analysis	Resolution
1	The transducer extension module cannot be powered (when power on, there is no relay switching sound), LED D15 and D16 do not illuminate.	Check if the control cable (connecting "control and power connect socket"J6) is loose (check extension module body, then check extension module connector); check if the cable is cracked (socket connector).	Reconnect or replace the cable.
		Check if the fuse F1 is conductive.	replace the fuse
2	The main unit cannot recognize the transducer connected via the transducer extension module.	The transducer extension module cannot provide power (when power on, there is no relay switching sound).	Refer to the resolutions mentioned above.

No.	Failure Description	Cause Analysis	Resolution
		Test if 5V, 3.3V, 1.8V testing point voltages of the B transducer extension board are correct.	If there is no short-circuited, do the following: If 1.8V is not correct, replace U2; If 3.3V is not correct, replace U8; If 5V voltage is too low, the end of the main unit may be damaged (if you illegally perform hot swapping to the transducer extension module, it may cause the main board damage)
		Check if “control and power cable ” is loose or damaged (ensuring communication signal cable is correctly connected)	Reconnect or replace the cable.
		Check if two boards and cards of the extension module are securely buckled.	If not, buckle the two boards and cards.
		CPLD U5, driver U3, or U4 is damaged.	Return the extension module for service.
3	The main unit cannot recognize the A or B transducers connected via the transducer extension module (Note the difference with the failure description 2) (Note)	U6 (A) or U7 (B) is damaged.	replace the device
		The resistor connected with AID or CID signal is broken or short-circuited.	replace the resistor
4	When the transducer scans, only half of an image is normal, the other half is abnormal (there is noise or even image is obtained from the transducer via another transducer port)	Device Q3 or Q4 is damaged	replace the device
		The driver U1 is damaged, or peripheral resistor is damaged.	replace the device
		The control signal pin of the CPLD U5 is damaged.	replace U5 (the failure probability is rather low)
5	When A or B transducer scans, 1/8 or 1/4 of the area doesn’t display image.	Relay K65 or K66 is damaged, or its peripheral device is damaged.	replace the device
6	There is one or more than one dark strips in the image.	Check if the problem is still there when the transducer is directly connected to the main unit.	If the problem occurs for any transducer, it indicates the main board of the main unit is damaged. If the problem occurs for one certain transducer, it indicates the transducer is damaged.

No.	Failure Description	Cause Analysis	Resolution
		Check if the problem occurs for both A and B transducers.	If the problem occurs for both A and B transducers, it indicates: 1. The transducer signal cable is damaged; 2. The transducer signal cable is not tightly connected to the socket (the probability is big); 3. The socket for the transducer signal cable is damaged; 4. If the two dark strips are continuous, the corresponding relay is damaged. If the problem occurs for either A or B transducer, it indicates: 1. The two boards and cards in the extension module are not buckled tightly. 2. The “board-to-board” sockets for boards and cards are damaged. 3. The transducer port in the extension module is damaged.

Note:

Because this failure service needs to be performed in special fixture, so it shall be returned for service.

⚠WARNING: The transducer extension module doesn’t support hot swapping, so the hot swapping may cause damage of the transducer extension module or the main unit.

Appendix A Interface Definition

Index

Table 3-1 DC Power Output....3-2

Table 3-2 Signal Definition of Connectors between Main Power Board and System Main Board....3-4

Table 3-3 Signal Definition of Connectors between Main Power Board and Auxiliary Power Board....3-5

Table 3-4 Power Indicators in M5 Main Board....3-14

Table 3-5 Indicators in the Control Panel....3-14

Table 3-6 Interfaces of Main Board and Transducer Board....3-15

Table 3-7 Interface Signals of Main Board and Transducer Board....3-17

Table 3-8 Input Interfaces of Transmission Board....3-17

Table 3-9 Output Interfaces of Transmission Board....3-19

Table 3-10 CW CON1 Interface Pins....3-21

Table 3-11 Interface Signals of CW CON1....3-21

Table 3-12 CW CON2 Interface Pins....3-22

Table 3-13 Sockets of Main Board Clock Chip JTAG....3-23

Table 3-14 Interface Signals of Main Board and 4D Board....3-23

Table 3-15 Interfaces of Main Board and Modulation Module....3-24

Table 3-16 Interfaces of Main Board and Speakers....3-25

Table 3-17 Interfaces of Main Board and Fan....3-25

Table 3-18 Sockets of Main Board CPLD JTAG....3-26

Table 3-19 reserved signal interfaces....3-26

Table 3-20 Reserved Power Interfaces....3-26

Table 3-21 interfaces of the main board and battery connection board....3-27

Table 3-22 interfaces of the main board and adapter....3-27

Table 3-23 interfaces of the main board and power board....3-28

Table 3-24 interface signals of main board and power board....3-29

Table 3-25 Interface Signals of Main Board and Extension Module....3-30

Table 3-26 interfaces of the main board and keyboard....3-30

Table 3-27 Testing Points of Main Board....3-32

Table 3-28 testing points of the transmission board....3-33

Table 3-29 analog signal interfaces....3-39

Table 3-30 analog signal interface 3-39
Table 3-31 digital signal interfaces.....3-40
Table 3-32 digital signal interfaces.....3-40
Table 3-33 4D pencil probe interfaces 3-41
Table 3-34 pencil probe interfaces.....3-41
Table 3-35 keyboard board socket definition 3-47
Table 3-36 ECG board socket description 3-50
Table 8-1 information of power testing points.....8-15

Appendix B Electrical Safety Inspection

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the patient or the operator. Additional tests may be required according to local regulations.

All tests can be performed using commercially available safety analyzer test equipment. These procedures assume the use of a 601PRO$_{XL}$ International Safety Analyzer or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe such as Fluke, Metron, or Gerb may require modifications to the procedure. Follow the instructions of the analyzer manufacturer.

The consistent use of a safety analyzer as a routine step in closing a repair or upgrade is emphasized as a mandatory step if an approved agency status is to be maintained. The safety analyzer also proves to be an excellent troubleshooting tool to detect abnormalities of line voltage and grounding, as well as total current loads.

ELECTRICAL SAFETY INSPECTION 1- Power Cord Plug
TEST PROCEDURE

◆ The Power Plug	
The Power Plug Pins	No broken or bent pin. No discolored pins.
The Plug Body	No physical damage to the plug body.
The Strain Relief	No physical damage to the strain relief. No plug warmth for device in use.
The Power Plug	No loose connections.
◆ The Power Cord	
The Power Cord	No physical damage to the cord. No deterioration to the cord. --For devices with detachable power cords, inspect the connection at the device. --For devices with non-detachable power cords, inspect the strain relief at the device.

ELECTRICAL SAFETY INSPECTION

2- Device Enclosure And Accessories

TEST PROCEDURE	
◆ Visual Inspection	
The Enclosure and Accessories	No physical damage to the enclosure and accessories.
	No physical damage to meters, switches, connectors, etc.
	No residue of fluid spillage (e.g., water, coffee, chemicals, etc.).
	No physical damage to probe head (e.g., crack)
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).
◆ Contextual Inspection	
The Enclosure and Accessories	No unusual noises (e.g., a rattle inside the case).
	No unusual smells (e.g., burning or smoky smells, particularly from ventilation holes).
	No taped notes that may suggest device deficiencies or operator concerns.

ELECTRICAL SAFETY INSPECTION

3- Device Labeling

TEST PROCEDURE

Check the labels provided by the manufacturer or the healthcare facility is present and legible.

- *Main Unit* Label
- *Integrated Warning* Labels
- *Slope and High Voltage Caution* Label
- *Don't Stress* Label

ELECTRICAL SAFETY INSPECTION

5- Earth Leakage Test

OVERVIEW

Run an Earth Leakage test on the device being tested before performing any other leakage tests.

Leakage current is measured the following ways:

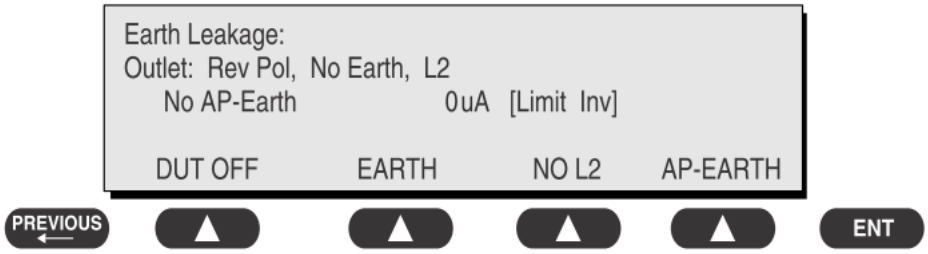
- Earth Leakage Current, leakage current measured through DUT outlet Earth
- Earth Leakage Current AP-EARTH (ALL Applied Parts connected to Earth), leakage current measured through DUT outlet Earth

There is no need to attach a test lead; the 601PRO automatically connects the measuring device internally.

TEST PROCEDURE

◆ Perform the Test

1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
2) Attach the device's applied parts to the 601PRO applied part terminals if applicable.
3) Press shortcut key 4.The Earth Leakage test appears on the display, and the test begins immediately:



- SOFT KEY 1 toggles the DUT outlet Polarity from Normal to Off to Reverse.
- SOFT KEY 2 toggles the DUT outlet from Earth to No Earth.
- SOFT KEY 3 toggles the DUT outlet from L2 to No L2.
- SOFT KEY 4 toggles the AP to Earth to No AP to Earth.

4) Press the print data key at any time to generate a printout of the latest measurement.

ELECTRICAL SAFETY INSPECTION

5- Earth Leakage Test

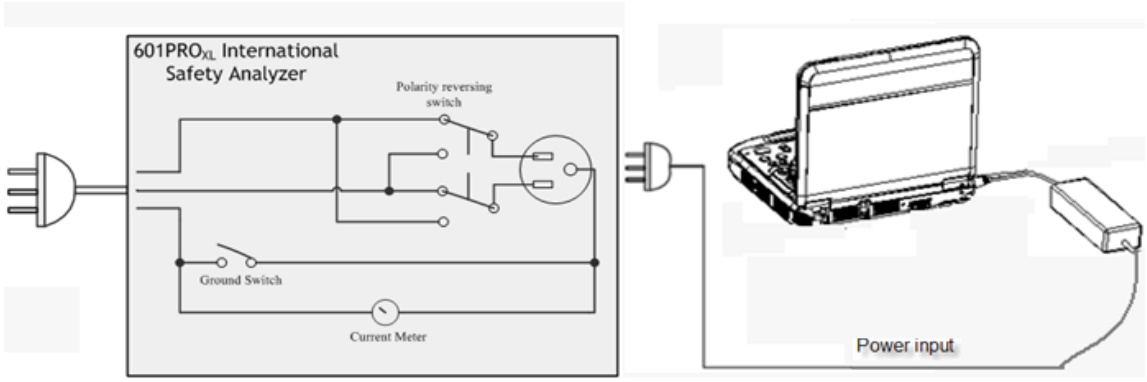


Figure 1 Earth leakage test

◆ Failure

Check any short-circuits of the Y capacitor on power unit. Replace a new one if any portion defective.

Check any broken of the Power Unit. Replace a new one if any portion defective.

Inspect mains wiring for bad crimps, poor connections, or damage.

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

Change another probe to confirm if the fail is caused by console.

Inspect mains wiring for bad crimps, poor connections, or damage.

If the leakage current measurement tests fail on a new unit and if situation cannot be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

UL60601-1：300 μA Normal Condition

1000 μA Single Fault Condition

IEC60601-1： 500 μA Normal Condition

1000 μA Single Fault Condition

ELECTRICAL SAFETY INSPECTION

6- Patient Leakage Current

OVERVIEW

Patient leakage currents are measured between a selected applied part and mains earth.

TEST PROCEDURE

◆ Prepare

Perform a calibration from the Mains on Applied Part menu.

The following outlet conditions apply when performing this test:

Normal Polarity, Earth Open, Outlet ON	Normal Polarity, Outlet ON
Normal Polarity, L2 Open, Outlet ON	Reversed Polarity, Outlet ON
Reversed Polarity, Earth Open, Outlet ON	Reversed Polarity, L2 Open, Outlet ON

◆ Warning

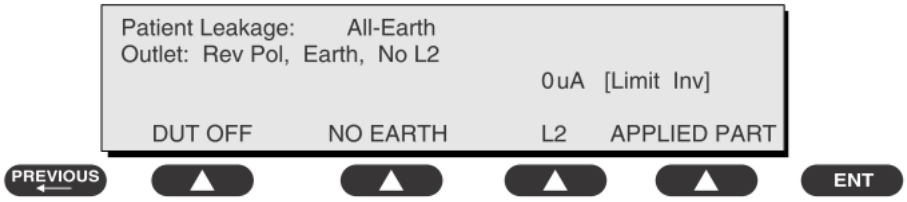
If all of the applied parts correspond to the instrument type, the applied parts will be tied together and one reading will be taken. If any of the applied parts differ from the instrument type, all applied parts will be tested individually, based on the type of applied part. This applies to Auto and Step modes only.

◆ Perform the Test

1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.

2) Attach the applied parts to the 601PRO's applied part terminals.

3) Press shortcut key 6. The Patient Leakage test is displayed, and the test begins immediately.



4) Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current.

5) Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the 601PRO.

ELECTRICAL SAFETY INSPECTION

6- Patient Leakage Current

6) Press the print data key at any time to generate a printout of the latest measurement.

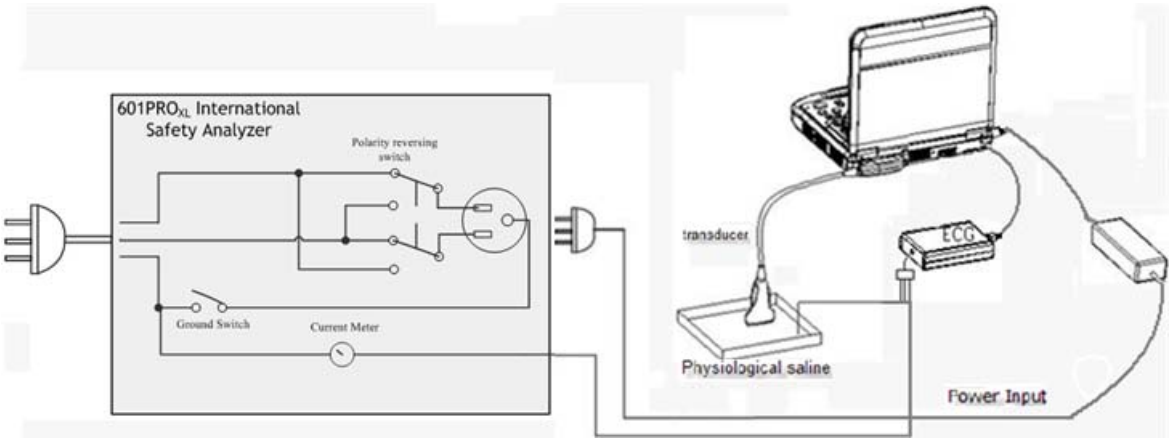


Figure 2 patient leakage Current

◆ Note

1, In addition to Probes ,Patient leakage current test should be perform if ECG or PCG parts used;

2, If the current test standard being used does not include Patient Leakage DC readings, or the DC option is not enabled, then DC readings will not be available through the APPLIED PART SOFT KEY selections. Refer to Chapter 8, Standards and Principles.

◆ Failure

Check any broken of the Applied parts. Replace any defective one.

Check any broken of the ECG/PCG module if used, Replace any defective one.

Check any broken of the Power Unit. Replace a new one if any portion defective.

Inspect wiring for bad crimps, poor connections, or damage.

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

Change another probe to confirm if the fail is caused by console.

Inspect wiring for bad crimps, poor connections, or damage.

If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

ELECTRICAL SAFETY INSPECTION

6- Patient Leakage Current

All countries

For BF ECG input and transducer

100 μ A Normal Condition

500 μ A Single Fault Condition

ELECTRICAL SAFETY INSPECTION

7- Mains on Applied Part Leakage

OVERVIEW

The Mains on Applied Part test applies a test voltage, which is 110% of the mains voltage, through a limiting resistance, to selected applied part terminals. Current measurements are then taken between the selected applied part and earth. Measurements are taken with the test voltage (110% of mains) to applied parts in the normal and reverse polarity conditions as indicated on the display.

The following outlet conditions apply when performing the Mains on Applied Part test.

Normal Polarity;

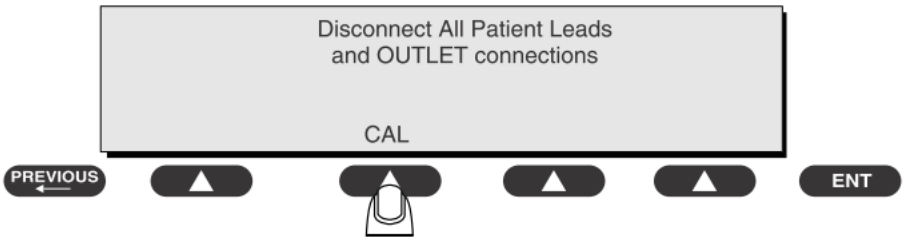
Reversed Polarity

TEST PROCEDURE

◆ Prepare

To perform a calibration from the Mains on Applied Part test, press CAL (SOFT KEY 2).

1) Disconnect ALL patient leads, test leads, and DUT outlet connections.
2) Press CAL to begin calibration, as shown:



If the calibration fails, the previously stored readings will be used until a passing calibration has occurred. Also, the esc/stop key has no effect during calibration.

3) When the calibration is finished, the Mains on Applied Part test will reappear.

◆ Warning

1) A 2-beep-per-second signal indicates high voltage present at the applied part terminals while a calibration is being performed.
2) High voltage is present at applied part terminals while measurements are being taken.

◆ Performance

1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601

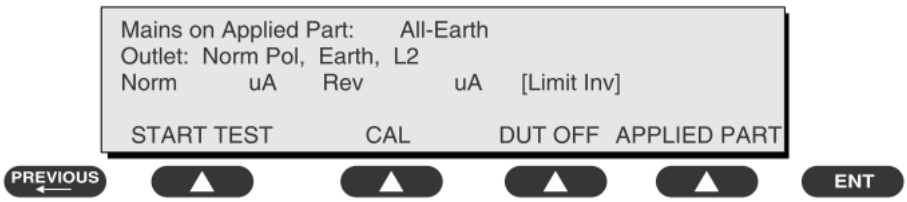
ELECTRICAL SAFETY INSPECTION

7- Mains on Applied Part Leakage

2) Attach the applied parts to the 601PRO applied part terminals.

3) Attach the red terminal lead to a conductive part on the DUT enclosure.

4) Press shortcut key 7. The Mains on Applied Part test is displayed.



5) Select the desired outlet configuration and applied part to test using the appropriate SOFT KEYS:

6) Press START TEST (SOFT KEY 1) to begin the test.

7) Press the print data key to generate a printout of the latest measurement.

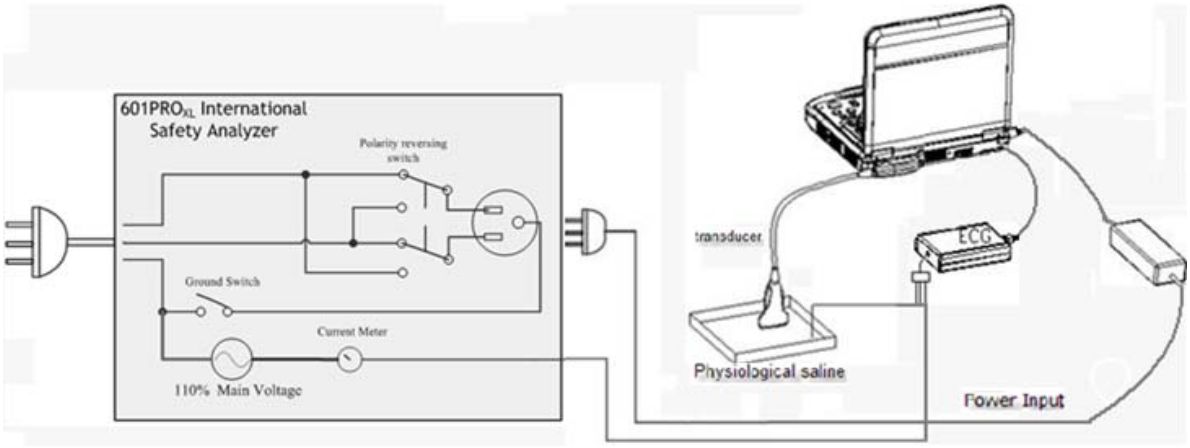


Figure 3 Mains on Applied part leakage

◆ Note

1, In addition to Probes ,Patient leakage current test should be perform if ECG or PCG parts used;

2, If all of the applied parts correspond to the instrument type, the applied parts will be tied together and one reading will be taken. If any of the applied parts differ from the instrument type, all applied parts will be tested individually, based on the type of applied part. This applies to Auto and Step modes only.

◆ Failure

Check any broken of the Applied part. Replace any defective one.

Check any broken of the ECG/PCG module if used, Replace any defective one.

Check any broken of the Power Unit. Replace a new one if any portion defective.

ELECTRICAL SAFETY INSPECTION

7- Mains on Applied Part Leakage

Inspect wiring for bad crimps, poor connections, or damage.

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

Change another probe to confirm if the fail is caused by console.

Inspect wiring for bad crimps, poor connections, or damage.

If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

All countries:

For BF ECG input and transducer:

5000 μ A

ELECTRICAL SAFETY INSPECTION

8- Patient Auxiliary Current

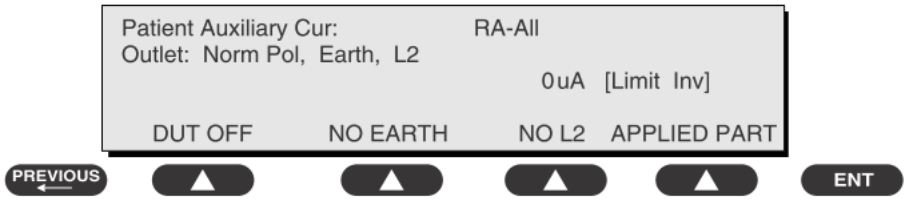
overview

Patient Auxiliary currents are measured between any selected ECG jack and the remaining selected ECG jacks.

TEST PROCEDURE

◆ Prepare

1) From the MAIN MENU, or with the outlet unpowered, plug the DUT into the 601PRO front panel outlet, and turn on the device.
2) Attach the patient leads to the 601PRO ECG jacks.
3) Define the Lead Types from the View Settings Option (refer to: Lead Type Definitions in Section 5 of this chapter).
4) Press shortcut key 8. The Patient Auxiliary Current test is displayed, and the test begins immediately. Display values are continuously updated until another test is selected.



5) Press SOFT KEYS 1-4 to select leakage tests
6) Press APPLIED PART (SOFT KEY 4) at any time to select the desired applied part leakage current:
7) Modify the configuration of the front panel outlet by pressing the appropriate SOFT KEY on the 601PRO:
8) Press the print data key at any time to generate a printout of the latest measurement.

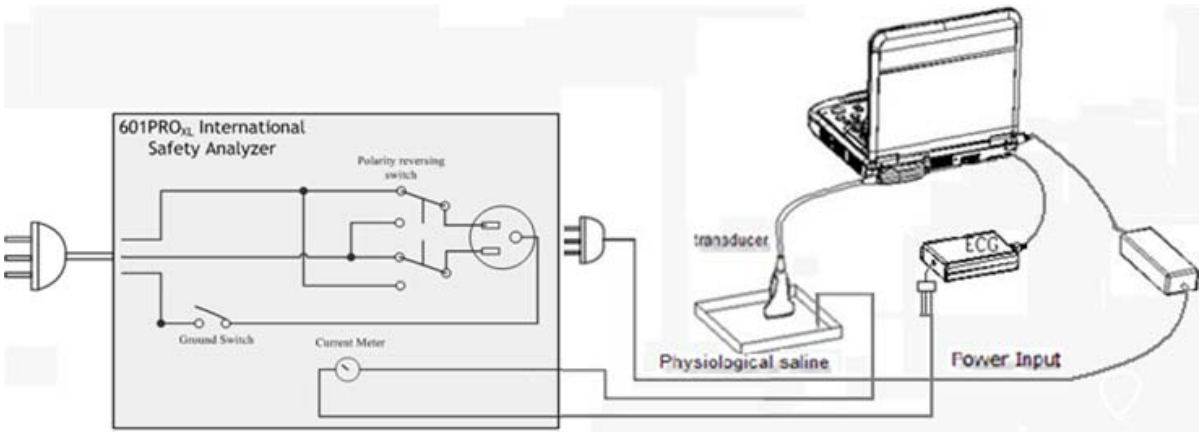


Figure 4 patient Auxiliary Current

ELECTRICAL SAFETY INSPECTION

8- Patient Auxiliary Current

◆ Note

If the current test standard being used does not include Patient Auxiliary Current DC readings, or the DC option is not enabled, then DC readings will not be available through the APPLIED PART SOFT KEY selections.

◆ Failure

Check any broken of the AC cable. Replace a new one if any portion defective.

Check any broken of the enclosure. Replace any defective part.

Inspect wiring for bad crimps, poor connections, or damage.

Test the wall outlet; verify it is grounded and is free of other wiring abnormalities. Notify the user or owner to correct any deviations. As a work around, check the other outlets to see if they could be used instead.

Change another probe to confirm if the fail is caused by console.

Inspect wiring for bad crimps, poor connections, or damage.

If the leakage current measurement tests fail on a new unit and if situation can not be corrected, submit a Safety Failure Report to document the system problem. Remove unit from operation.

If all else fails, stop using and inform the Customer Service Engineer for analysis and disposal.

LIMITS

All countries

For BF ECG input and transducer

100 μA Normal Condition

500 μA Single Fault Condition

ELECTRICAL SAFETY INSPECTION FORM

（Class I equipment）

Overall assessment:

□ Scheduled inspection — Test item: 1, 2, 3, 9

□ Unopened repair type — Test item: 1, 2, 3, 9

□ Opened repair type, not modify the power part including transformer or patient circuit board — Test item: 1, 2, 3, 4, 5, 9

□ Opened repair type, modify the power part including transformer or patient circuit board — Test item: 1, 2, 3, 4, 5, 6, 7, 8, 9

Location:				***Technician:***	
Equipment:				***Control Number:***	
Manufacturer:		***Model:***		***SN:***	
Measurement equipment /SN:				***Date of Calibration:***	
INSPECTION AND TESTING				***Pass/Fail***	***Limit***
1	***Power Cord Plug***				
2	***Device Enclosure and Accessories***				
3	***Device Labeling***				
4	***Protective Earth Resistance***		***Ω***		***Max 0.2 Ω***
5	***Earth Leakage***	***Normal condition(NC)***	***____μA***		***Max: NC: 300μA(refer to UL60601-1) * NC: 500μA(refer to IEC60601-1) * SFC: 1000μA***
		Single Fault condition(SFC)	***____μA***		
6	***Patient Leakage Current***	***Normal condition(NC)***	***□BF____μA***		***Max: BF applied part: NC:100μA, SFC: 500μA***
		Single Fault condition(SFC)	***□BF____μA***		
7	***Mains on Applied Part Leakage***		***□BF____μA***		***Max: BF applied part: 5000μA***
8	***Patient Auxliary Leakage Current***	***Normal condition(NC)***	***□BF____μA***		***Max: BF applied part: NC:100μA, SFC: 500μA***
		Single Fault condition(SFC)	***□BF____μA***		

Note:

The equipment which sell to America shall comply with the requirement of UL60601-1, others shall comply with the requirement of IEC60601-1.

Name/ Signature: _____ Date:_____

Appendix C Phantom Usage Illustration

Targets Disposal of Phantom KS107BD

A1——A5： Axial resolution target group B: Blind-area target group

C： Longitudinal target group D： Horizontal target group

E: Mimic tumor F： Mimic sac (diam 10mm) and stone

G Mimic sac (diam 6mm)

4. Line Target System

There are 8 groups of nylon line targets disposed as shown in the figure.

1．A1——A5：

Axial and lateral resolution target group. The distances between the horizontal branch and the acoustic window are 30, 50, 70, 120 and 160mm, the center horizontal distances between two adjacent lines of A1 and A2 groups are 1, 5, 4, 3, 2mm, A3~A5 groups are 5, 4, 3, 2mm. The center longitudinal distances between two adjacent lines of the longitudinal branches are 4, 3, 2, 1mm.

2．B：

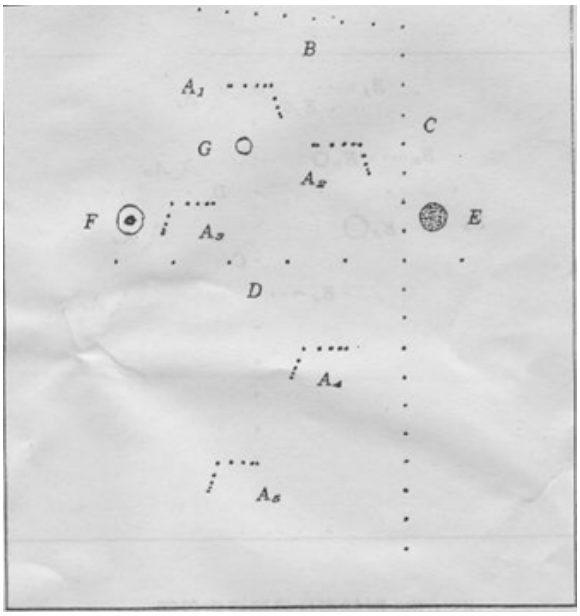
Blind-area target group. Center horizontal distance of adjacent lines is 10mm, distances to the acoustic window are 10, 9, 8, 7, 6, 5, 4, 3mm.

3．C：

Longitudinal target group. 19 target lines with a 10mm center distance between adjacent lines.

4．D：

Horizontal target group. 7 target lines with a 20mm center distance between adjacent lines.



Targets disposal- KS107BD

A1——A4 Axial resolution target group

B1——B4 Lateral resolution target group

C Longitudinal target group

D Horizontal target group

E1——E3 Mimic sacs with diameters of 2, 4, 6mm

4. Line Target System

There are 8 groups of line targets disposed in TM material as shown in the figure.

1．A1——A4：

Axial resolution target group. The upmost lines in each target locate at the depth of 10, 30, 50, 70mm, the center longitudinal distances of each group (from the top down) are 3, 2, 1, 0.5mm, and the horizontal distance is 1mm.

2．B1——B4：

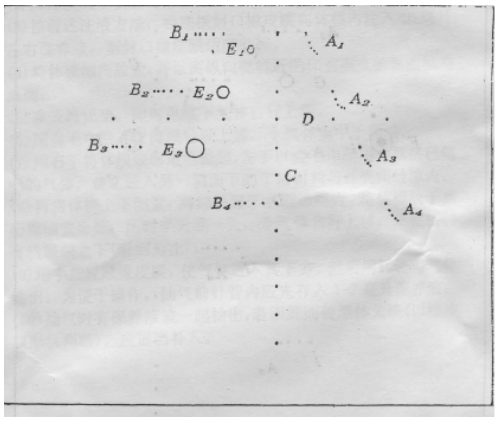
Lateral resolution target group. Locate at a depth of 10, 30, 50, 70mm, with a center horizontal distance of 4, 3, 2, 1mm in each group.

3．C：

Longitudinal target group. 12 target lines with a 10mm center distance between adjacent lines.

4．D：

Horizontal target group. Locate at a depth of 40mm, with a 20mm center distance between adjacent lines.


B1
E1
A1
B2
E2
A2
D
B3
E3
A3
C
B4
A4

P/N: 2108 -20-65978 (V14.0)